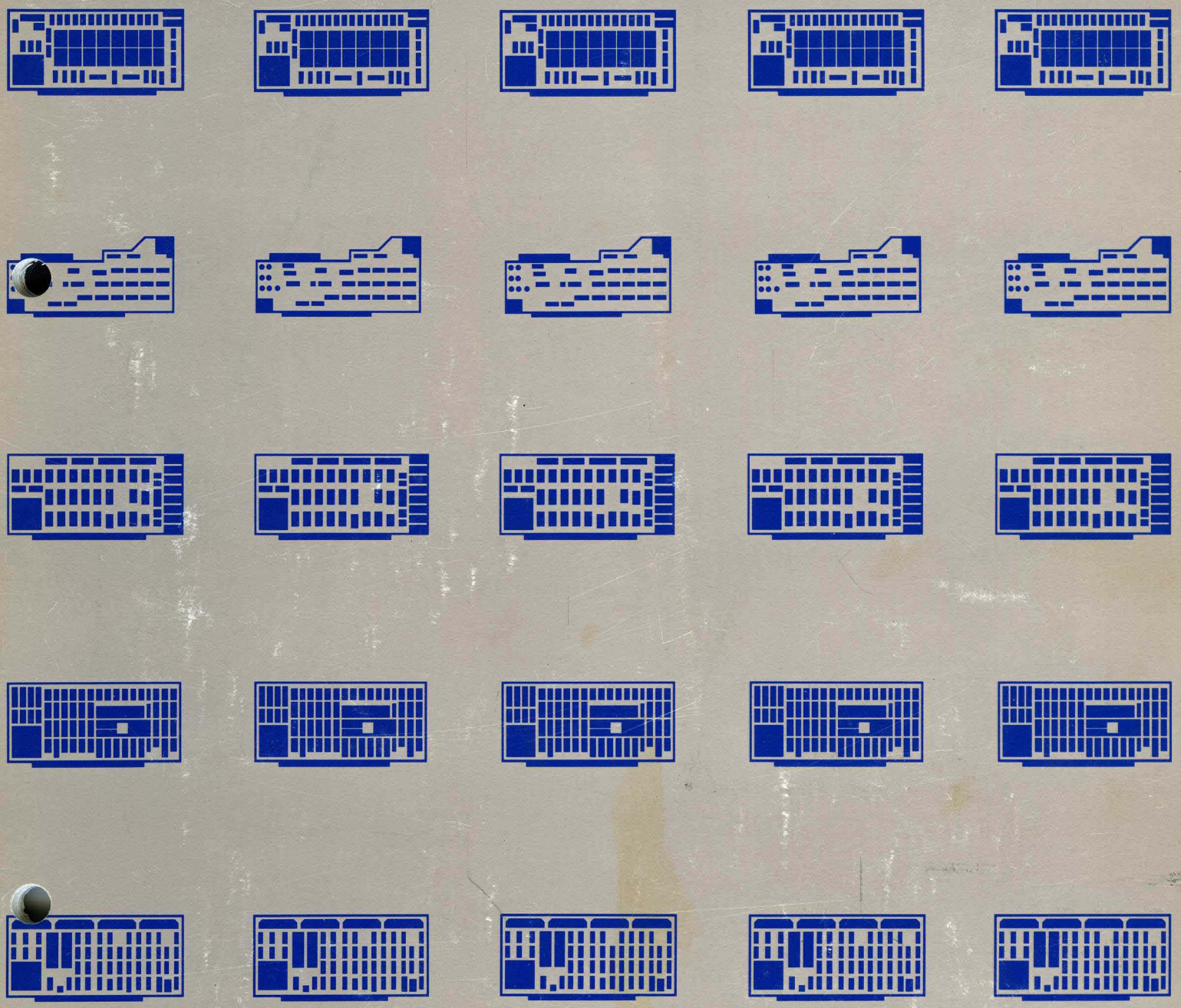
Cromemco

Board Level
Product Catalog



Cromemco

Board Level
Product Catalog

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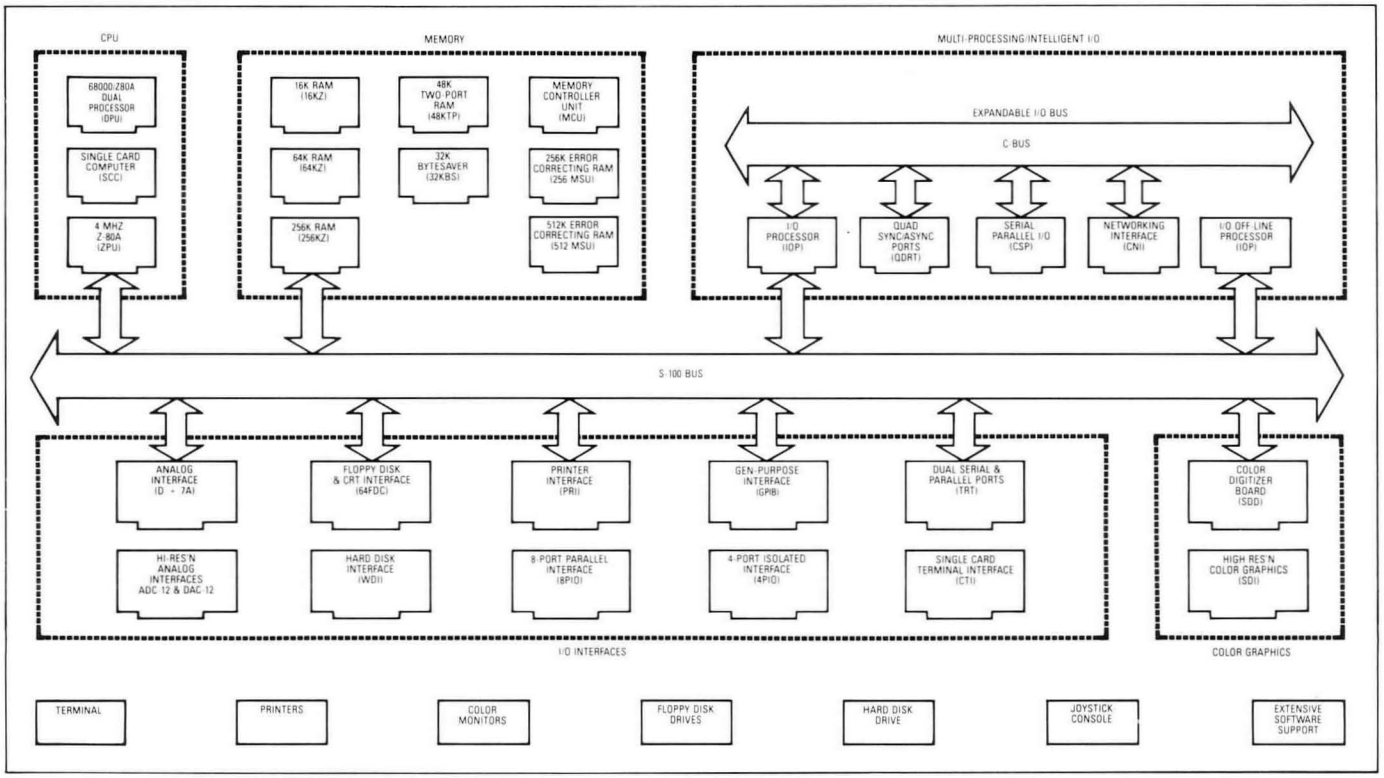
CROMEMCO AND S-100 STRUCTURES



Cromemco is the world's largest manufacturer of microcomputers based on the S-100 bus. The S-100 bus is the best building-block system for OEM computer applications and the most flexible system for designing modular computer systems.

The S-100 bus structure was invented the same year Cromemco was founded, 1975. The bus allows all system components to interrelate to each other.

With S-100 boards you can achieve your system goals with the greatest efficiency, speed and economy of design. The large number of connector pins (100), the high speed (10 MHz) bus clock, the large (16M byte) addressable memory and other technical features make the S-100 bus ideal for industrial, business, and scientific computer applications.

The Cromemco philosophy of S-100 boards and support system components is to apply state-of-the-art technology and excellent engineering to every part of the design. As a result, our boards are efficient, high quality products that are easy to use.

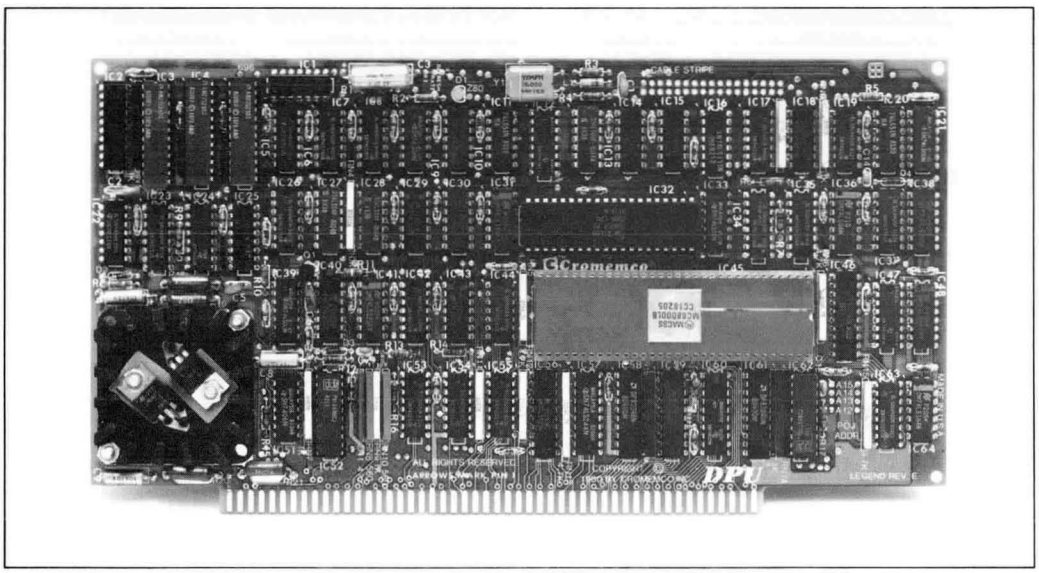
In order to retain high speed operation while avoiding noise problems, we use a special ground-plane design in all our boards. For every S-100 bus signal line we have added a ground line. This cuts RF crosstalk, noise, and the errors these can cause.

Since Cromemco's system level products use the S-100 bus, the board products have a proven record of performance. We have very high quality standards for every board product we produce. It is standard procedure to extensively test and burn-in every board we sell. This is one reason why Cromemco has rated first in reliability on independent surveys.

Cromemco also has extensive lines of software and development tools and established, dependable field engineering and service organizations. Besides our factory staff, we offer the full support of the TRW third party service organization.

CENTRAL PROCESSOR UNIT BOARDS

MODEL DPU
Dual Processor Unit with Companion Memory



A FAST, EASY WAY TO START WITH THE 68000

The new Dual Processor Unit gives you an easy way to get started with the impressive 68000 microprocessor, which is widely acknowledged as the most powerful of the new processors. It has 32-bit wide internal architecture, 24 address lines allowing it to address 16 megabytes, 56 main instruction types, five main data types, and 14 addressing modes.

8-BIT AND 68000 SOFTWARE

As the name implies, the DPU has both a Z-80A and the 68000 on board. This gives access to a wide variety of existing CP/M and other 8-bit software as well as a family of new software such as a 68000 Assembler, FORTRAN 77, Pascal, BASIC, COBOL and C. Switching between the 68000 and the Z-80A on the DPU is software-controlled.

Cromemco also offers the CROMIX operating system, which is similar to UNIX but has even more features and gives multi-tasking and multi-user capability.

Present customers can field-upgrade their Cromemco systems to use the DPU and still be able to run their present software with the Z-80A on the DPU.

RAM Memory units for use with the DPU are also available (see the specifications on page 9).

TECHNICAL SPECIFICATIONS

Processors:
68000 and Z-80A

Clock Rate:
68000: 8MHz
Z-80A: 4MHz

Instruction Set:
68000: over 1000 instructions in 56 main types
Z-80A: 158 instructions including the 78 instructions of the 8080A processor

Power-on Jump:
Cromemco processor standard system, as well as user selectable jumps to any 4K memory boundary

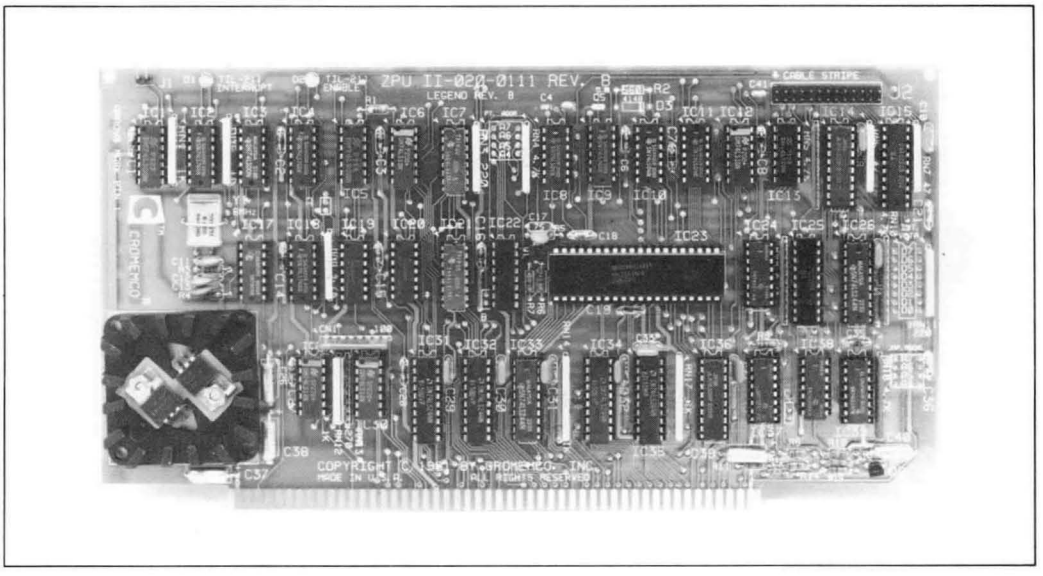
Processor Control:
Software controlled switching between 68000 and Z-80A

Bus:
S-100 (Jumper selectable to IEEE-696)

Power Requirements:
+8 volts @ 2.0 amps
± 18 volts not used

Operating Environment:
0–55 degrees Centigrade

MODEL ZPU
Central Processing Unit



Cromemco's ZPU is an S-100 bus compatible CPU (Central Processing Unit) which uses the powerful Z-80A microprocessor. The ZPU has an advanced set of features designed to increase total system computing power. Most importantly, the ZPU operates reliably at a 4 MHz clock rate—twice the speed of most other microcomputer systems. The ZPU also offers power-on-jump capability, an onboard wait state generator, optional independent selection of M1 wait states, address mirroring circuitry, a parallel printer port, and priority interrupt capability.

4 MHz CLOCK RATE

The ZPU lets you choose either a 4 MHz or 2 MHz crystal-controlled clock rate. The clock rate is factory wired for 4 MHz and can be optionally jumpered for 2 MHz operation.

POWER-ON MEMORY JUMPS

With power turn-on, the ZPU will jump to any desired 4K boundary in memory. No switch flipping is needed to begin a program.

POWERFUL INSTRUCTION SET

The instruction set of the Z-80A contains 158 instructions, including the 78 instructions of the 8080A.

INTERRUPT CAPABILITY

The ZPU provides priority in/out daisy chain for the printer port. The board also provides interrupt and interrupt enable LEDs.

TECHNICAL SPECIFICATIONS

Processor:
4 MHz version of the Z-80A

Clock Rate:
4 or 2 MHz (jumper selectable)

Instruction Set:
158 instructions including the 78 instructions of the 8080A processor

Power-On-Jump:
Jumper selectable (factory shipped at C000)

Power-On-Jump Locations:
16 locations, jumper selectable

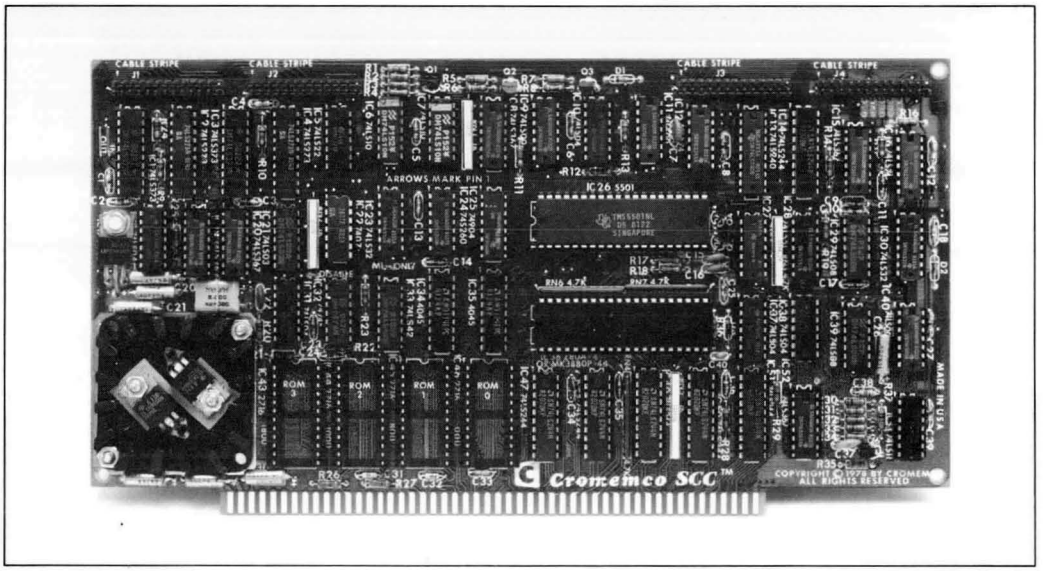
Interrupt Structure:
Priority in/out daisy chain for printer port. Interrupt and interrupt enable LEDs.

Bus:
S-100

Power:
+8 volts @ 1.1A
± 18 volts not used

Operating Environment:
0–55 degrees Centigrade

MODEL SCC
4 MHz Single Card Computer



A COMPLETE 4 MHz COMPUTER

The Single Card Computer (SCC) brings the power of the Z-80A and the flexibility of the S-100 bus to the dedicated computer environment.

This card was designed to get your application up and running fast. It offers 4 MHz operation, up to 8K bytes of on-board 2716 PROM, and 1K byte of static RAM memory. Interfacing is easy through the RS-232 (or 20 mA current loop) serial interface with programmable baud rates to 76,800 baud. This stand-alone card also gives you 24 bits of bidirectional parallel I/O, 5 programmable timers, vectored interrupts, and complete compatibility with all Cromemco cards.

The SCC is a complete computer. Only a power supply and your PROM software are required for operation. Yet it can be the core of an expandable S-100 bus system since additional memory, I/O, or even floppy disk drives can be added as the application requires.

MONITOR/3K BASIC

Cromemco's Z-80A Monitor and our 3K Control BASIC are available in 2716 ROM for use in the Single Card Computer. With this two-ROM set (Model MCB216) the SCC can be used immediately—no other memory or I/O is required. The monitor has 12 commands to aid in program development. The Control BASIC has 36 commands/functions and can directly access I/O ports and memory locations as well as call machine language subroutines.

TECHNICAL SPECIFICATIONS

Processor:
Z-80A

Instruction Set:
158 instructions

ROM Capacity:
8K Bytes located from address 0000 to 1FFF
2716 Programmable with 32K Bytesaver (Model 32KBS)

RAM Capacity:
1K Bytes located from address 2000 to 23FF

RAM Type:
4045, Static

Serial I/O Ports:
I/O levels: RS-232 or 20 mA current loop
Baud rate: 110 to 76,800 (software selectable)

Parallel Ports:
Input Port: 24 bits
Output Port: 24 bits
Input Load: One TTL equivalent
Output Drive: 20 TTL loads

Interval Timers:
Number of timers: 5
Timer range: 0–16.32 milliseconds (software selectable)
Timer resolution: 64 microseconds

Vectored Interrupts:
Number of restart locations (Z-80A mode): 65,536

UART type:
5501

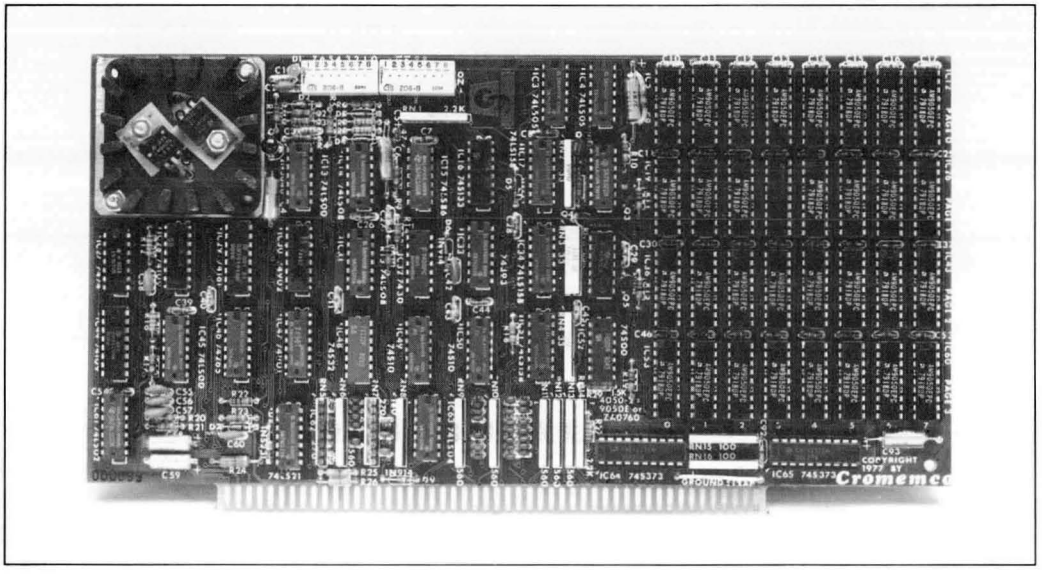
Bus:
S-100

Power Requirements:
+8 volts at 1.4A
+18 volts at 70 mA
−18 volts at 25 mA

Operating Environment:
0–55 degrees Centigrade

MEMORY BOARDS

MODEL 16KZ
16K RAM Card with Bank Select



FAST, EXPANDABLE

The 16KZ is the fastest 16K RAM card available, and it is expandable to a half Megabyte with Bank Select. It will operate at 2 or 4 MHz with no wait states.

This memory can be plugged into any single user, Z-80A based computer system.

MEMORY BANK SELECT

Memory Bank Select is a feature incorporated on Cromemco memory boards that allows the expansion of memory-space beyond 64K bytes. With bank select, memory space may be organized into 8 banks of 64K bytes each for a total of one-half Megabyte of memory.

Each memory board may reside in one or more of the 8 possible memory banks. An 8-position DIP switch on the board is used to select each of the banks in which the board resides.

The active bank or banks of memory are selected under software control. Output port 40H is dedicated to this function. Each of the 8 bits of data of output port 40H is used to turn the corresponding bank of memory on or off. A "1" in the corresponding bit position will turn on the memory bank. A "0" will turn it off. All circuitry required to detect the output of port 40H is included on the memory card itself.

TIME SHARING

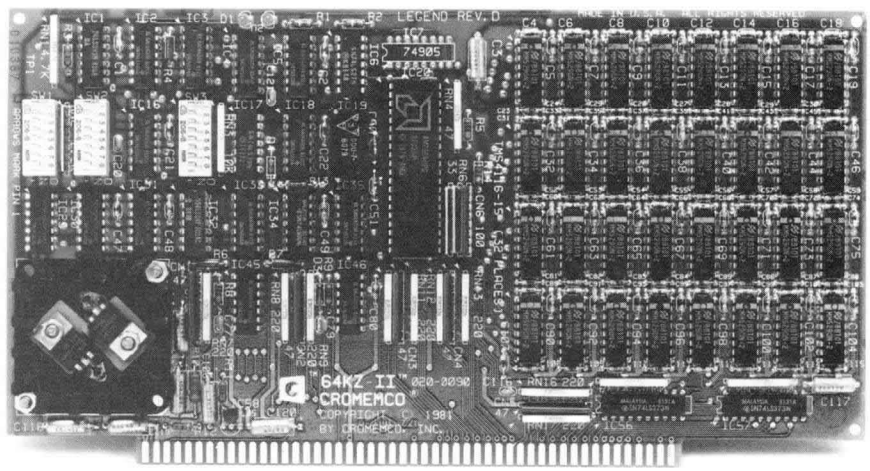
Bank select also permits the implementation of time-sharing systems with a minimum of software overhead—up to 6 users can use the system simultaneously with each user confined to a particular bank of memory.

TECHNICAL SPECIFICATIONS

Memory Capacity:
16K bytes
Memory Type:
4050-2 RAM
Memory Access Time:
200 nanoseconds
Wait States at 2 MHz:
None required
Wait States at 4 MHz:
None required

Bus:
S-100
Power Requirements:
+8 volts @ 0.8A
+18 volts @ 0.5A
−18 volts @ 10 mA
Operating Environment:
0–55 degrees Centigrade

MODEL 64KZ
64K RAM Card with Extended Bank Select



This 64K byte RAM card is fast and very expandable.

The Model 64KZ is organized as two 32K blocks of memory. Each block can be placed either in high-memory space (address 8000-FFFF) or low-memory space (address 0000-7FFF).

Each block can further be placed in any of 8 different memory banks. Address and bank assignment of each 32K block is switch selectable.

Another feature is that each 32K block can be independently switched to be selected or deselected after reset.

EXPANDABLE TO 512K

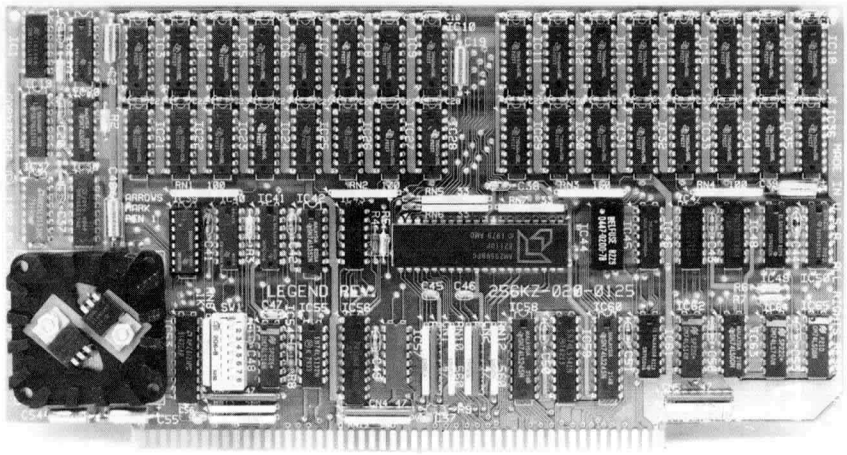
With our Bank Select feature you can expand memory space from 64K to 512K in eight banks. (See page 10 for a discussion of BANK SELECT.)

The 64KZ is fully tested to be compatible with all Cromemco Z-80 based products.

TECHNICAL SPECIFICATIONS

Memory Capacity:
64K bytes
Memory Type:
4116 RAM
Memory Access Time:
150 nanoseconds
Wait States at 2 MHz:
None required
Wait States at 4 MHz:
None required
Bus:
S-100
Power Requirements:
+8 volts @ 0.6A
+18 volts @ 0.2A
Operating Environment:
0–55 degrees Centigrade

MODEL 256KZ
256K RAM Card



Cromemco's 256KZ RAM card is an S-100 bus compatible 256K byte read/write memory board. This board is ideal for use with Cromemco's CROMIX multi-user, multi-tasking operating system.

In horizontal bank select mode, the 256KZ appears to be four 64KZ banks of memory. The 256KZ also implements the extended addressing capability required to utilize the full addressing power of the Cromemco DPU processor board. The 256KZ also incorporates 8-bit and 16-bit read/write operations in accordance with the IEEE-696 standard in order to further enhance the throughput of 16-bit systems. Extensive use of LSI and VLSI components reduces power consumption and increases reliability.

TECHNICAL SPECIFICATIONS

Memory Capacity:
256K Bytes

Memory Type:
4164-15 T2

Wait States:
None required (except during CROMIX initialization)

Memory Address Capabilities:
CROMIX-type bank switching and 24-bit extended addressing

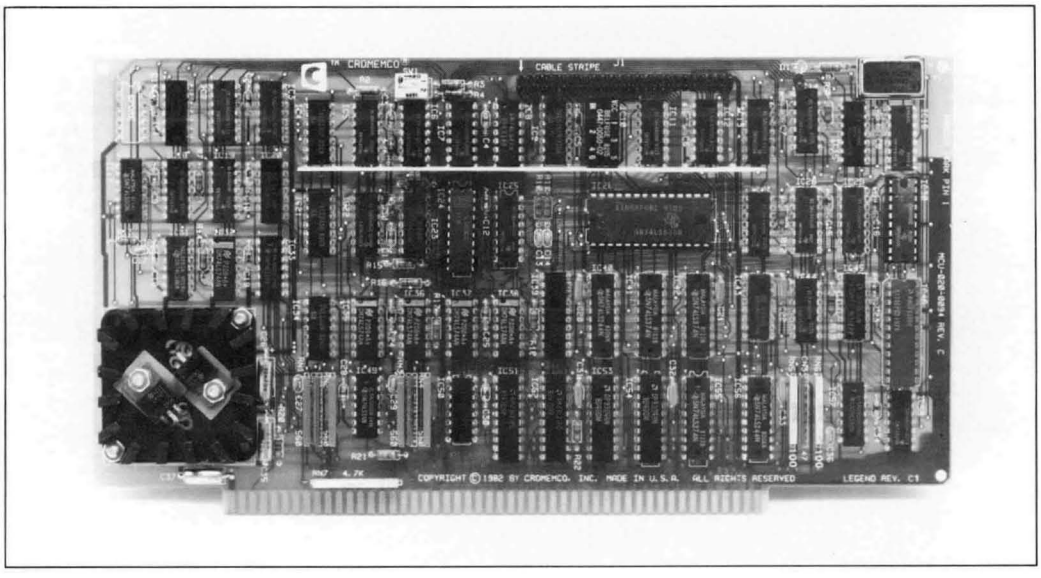
Data Path:
S-100 compatible (IEEE-696) 8/16-bit data read/writes

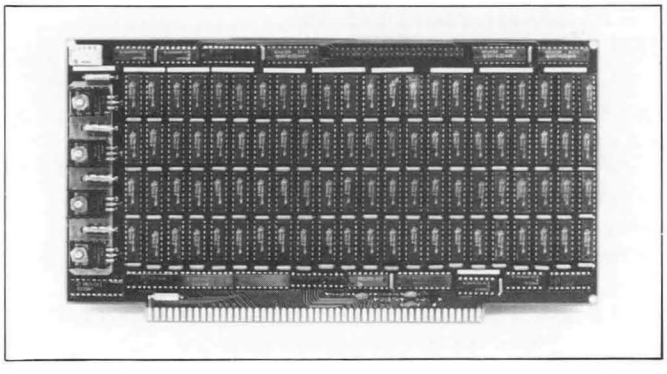
Bus:
S-100

Power Requirements:
8V @ 900 mA

Operating Environment:
0–55 degrees Centigrade

MODEL MCU and MODEL 512MSU
Memory Controller Unit and Memory Storage Unit





For use with the DPU, Cromemco offers a 512 kilobyte RAM memory unit. This unit works under the control of a new Memory Controller Unit (MCU) which supports either byte or word-width operation.

The Memory Controller Unit can control up to four Memory Storage Units—a total of 2 megabytes of RAM using the 512 kilobyte (512MSU) unit.

A special feature of the memory unit is its built-in error checking and correction capability. In concert with this capability the Memory Controller Unit has an error-logging feature which stores the location of errors encountered and identifies the particular MSU that had the error. This feature is very helpful in system diagnostic and maintenance work.

For error checking and correcting, the memory unit is designed to use 22 bits to encode each 16-bit word. A modified Hamming code is also used which allows transparent detection and correction of single-bit errors and detection of double-bit errors.

TECHNICAL SPECIFICATIONS

Model MCU

Support Capacity:
Up to four MSU memory cards

Address Space:
16 Megabytes

Bus:
S-100, (IEEE-696) compatible

Power Requirements:
+8 volts @ 1.5A
± 18 volts not used

Operating Environment:
0–55 degrees Centigrade

Model 512MSU

Memory Capacity:
256K by 22 bits; 512K bytes

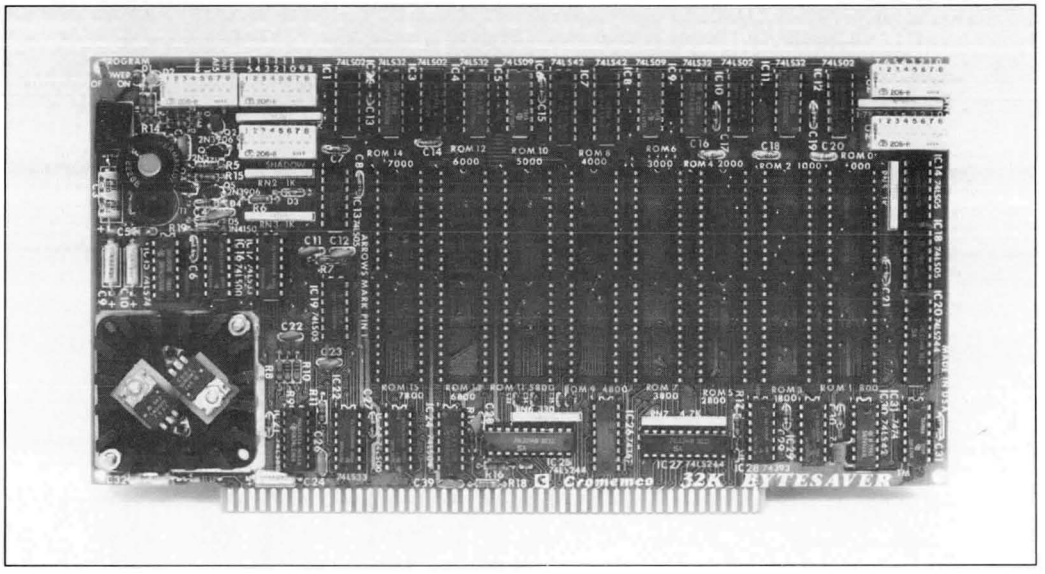
Memory Type:
64K dRAMs; 150 nanosecond access time

Bus:
S-100, (IEEE-696) compatible

Power Requirements:
+8 volts @ 1.5A

Operating Environment:
0–55 degrees Centigrade

MODEL 32KBS
32K BYTESAVER Memory Board with 2716 PROM Programmer



32K BYTESAVER PROGRAMS THE HIGH DENSITY 2716 PROM

The 32K BYTESAVER is an S-100 memory board and PROM programmer which uses the 2716 2-Kilobyte PROM.

Cromemco's 32KBS card has a full 32-kilobyte capacity of non-volatile storage for those ROM-intensive applications.

The user also gets the convenience of an on-board 2716 programmer.

The new 32K BYTESAVER holds up to sixteen 2716 PROMs. Switches are provided to:

Protect and unprotect PROMs individually or in groups for programming

Shadow ROM socket pairs (allows external RAM to overlap portions of ROM address space)

Select card address

Control the powerful Bank Select and DMA IN-OUT features.

NO SPECIAL SOFTWARE NEEDED

A simple, one-time write of the desired data into an erased PROM with the on-board programmer turned on is all that is required to store information quickly and permanently.

TECHNICAL SPECIFICATIONS

Memory Capacity:
32K bytes

Memory Type:
Intel 2716 PROM (single voltage version) or equivalent

Memory Access Time:
450 nanoseconds

Wait States at 2 MHz:
None required

Wait States at 4 MHz:
One per machine cycle

Bus:
S-100

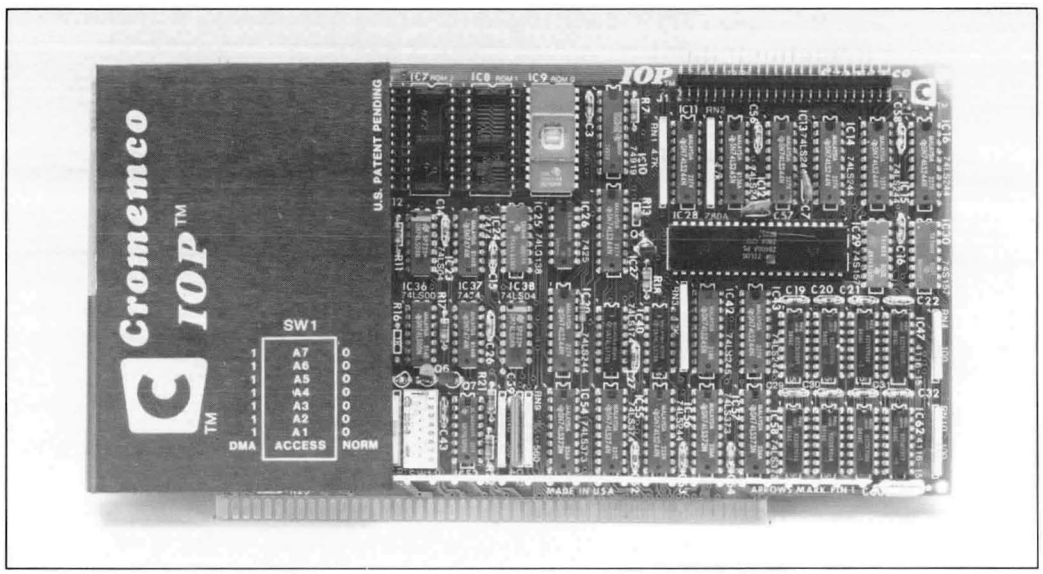
Power Requirements:
+8 volts @ 2.1A, max.
± 18 volts not used

Operating Environment:
0–55 degrees Centigrade

MICROCOMPUTER BOARD LEVEL PRODUCTS

INPUT/OUTPUT BOARDS

MODEL IOP
I/O Processor



MULTI-PROCESSOR CAPABILITY

With this new I/O Processor the user can have multi-processor capability in a S-100 bus system.

The new Model IOP is a true single-card process controller—one that has a fast Z-80A processor, 16K bytes of RAM, and up to 16K bytes of PROM capacity.

The IOP interfaces to the S-100 host processor by means of simple "input" and "output" instructions.

SATELLITE PROCESSOR

The IOP can be used either alone or with other IOP cards as a satellite processor on the S-100 bus.

Or the IOP can process I/O channels and interface to other devices such as the Cromemco QUADART through the C-bus connector on the top edge of the card.

The IOP is an advanced development that brings a new dimension of computer architecture to Cromemco computer systems.

TECHNICAL SPECIFICATIONS

Processor:
4 MHz Z-80A

Instruction Set:
158 instructions (including the 78 instructions of the 8080A processor)

ROM Capacity:
16K bytes positioned starting on any 2K boundary (selectable by bipolar PROM)

ROM Type:
Intel 2716, 2732 or equivalent

RAM Capacity:
16K bytes positioned starting on any 2K boundary (selectable by bipolar PROM)

Standard Address Configuration:
PROM — 000 to 1FFFH
RAM — 4000H to 7FFFH

RAM Type:
4116

Host Interface:
S-100 bus input-output ports

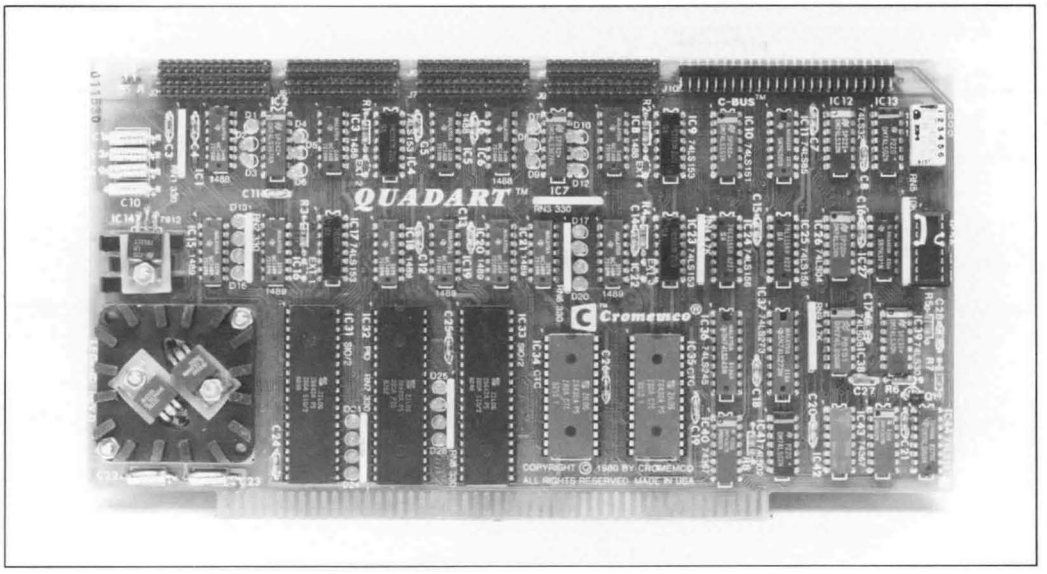
Peripheral Interface:
C-bus

M1 Wait State Generation:
0-1 wait states jumper wire selectable

Power Requirements:
+8 volts @ 1.5A
+18 volts @ 100 mA
−18 volts @ 30 mA

Operating Environment:
0–55 degrees Centigrade

MODEL QDRT
QUADART Serial Communications Interface



SIMULTANEOUSLY INTERFACES UP TO FOUR SERIAL CHANNELS

This versatile new QUADART serial communications interface card offers the power to satisfy virtually any high-speed data communications application.

The QUADART card is designed to operate with the I/O Processor (Model IOP). It includes four independent serial channels, each supporting Asynchronous, Synchronous byte mode (Bisync), and Synchronous bit mode (SDLC) protocols with complete handshaking for modems. Serial protocol is software-selectable for each channel.

The unique loopback feature gives the capability to connect data from any channel to any other channel, to connect data from any modem to any other modem, or to use any modem/channel combination for diagnostics and selftest.

Baud rates for each may be software-selected from 0 to 300K baud (asynchronous to 19,200 baud).

VECTORED INTERRUPTS

The QUADART also supports the powerful internally-prioritized vectored interrupt structure of the Z-80A microprocessor which has become a trademark of Cromemco interface cards.

INTERVAL TIMES

The QUADART has real-time clocking capability with four interval timers each having periods as small as 4.00 microseconds. Up to three timers can be cascaded to provide a 1.000-second time interval.

The software-selectable time range of each timer is 0 to 16.384 milliseconds.

C-BUS

The control for the QUADART is from the C-bus provided by Cromemco's powerful I/O processor computer, Model IOP. The IOP interfaces between the S-100 bus and the C-bus and can support up to four QUADARTs with full interrupt capability.

TECHNICAL SPECIFICATIONS

Serial Channels:
- Serial protocols:
  - Asynchronous Byte
  - Synchronous Byte (Bisync)
  - Synchronous Bit (SDLC)
  - Modem handshaking
- Number of channels: 4
- Diagnostics: Channel-to-channel diagnostic loopback capability (input/output channels software selectable)

Asynchronous Baud Range:
- 0 to 19,200 baud (software selectable)

Synchronous Baud Range:
- 0 to 300K baud (software selectable)

Interval Timers:
- Number of timers: 4
- Timer range: 0 to 16.384 msec (cascadable to 1.0 second, software selectable)
- Timer resolution: 4.0 microseconds

Vectored Interrupts:
- Number of restart locations (Z-80A mode): 65,536
- Prioritization of serial channels and timers: Internally prioritized
- Prioritization for multiple QUADARTs: daisy-chaining

Serial Channel Type: Z80-SIO/2

Parallel Channel Type: Z80-PIO

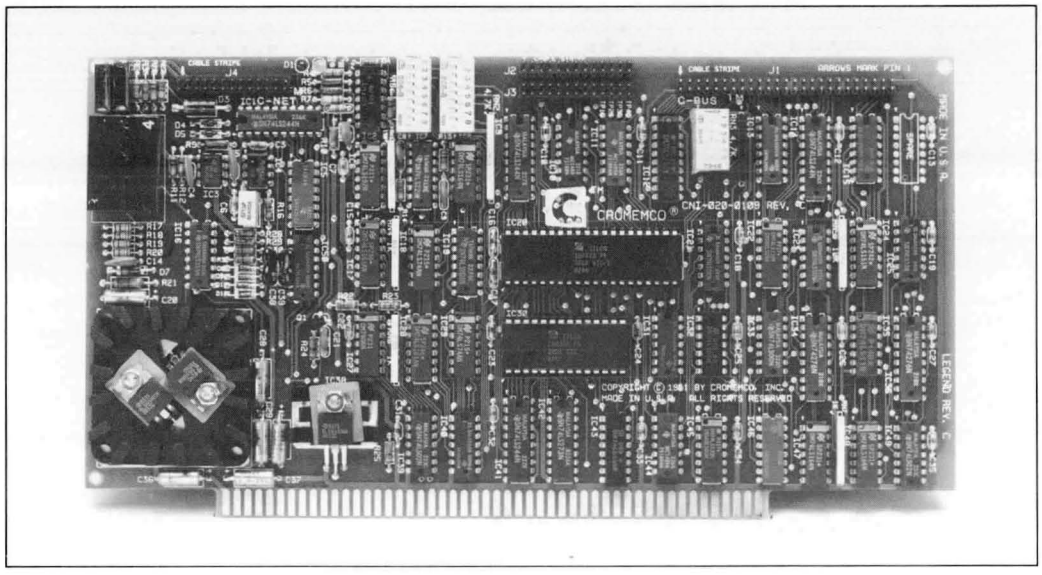
Timer Type: Z80-CTC

Interface: C-bus

Power Requirements: +8 volts @ 1.5A
+18 volts @ 100 mA
−18 volts @ 100 mA

Operating Environment:
- 0–55 degrees Centigrade

MODEL CNI
C-NET



The Cromemco Network (C-NET) is a network specification built around a rugged, shielded twin-axial cable and military specification MIL-STD-1553B. Cromemco's CNI C-NET Interface board interfaces the network medium (the physical data channel which interconnects network stations) to a 4 MHz Z-80A, single board computer with program storage (Cromemco's Input/Output Processor board). The CNI's isolation transformer and crystal controlled clock are optimized for operation with C-NET. The CNI provides a standard 500 kHz C-NET data rate and is adaptable for network data rates from 0 to 880 kHz.

The CNI also features a differential transmitter and receiver which rejects common mode noise. In addition, phase locked loop clock recovery minimizes noise sensitivity. Isolation transformer coupling isolates the network cable from node faults and protects the node electronics from network cable faults.

Bit protocol on the CNI is managed by an LSI circuit. The board provides vectored interrupts on network characters, network conditions, or programmable timers. Two uncommitted general purpose timer/counter circuits with extended timing intervals are also provided. The CNI includes an RS-232 serial port for use with a local terminal.

OPERATING MODES

The CNI board includes four programmable counter and timer circuits and an IOP to RS-232 interface (75 to 19,200 baud). This means that a complete, low cost, C-NET station can be built using only a power supply, a CNI board, an IOP board, and a CRT (or any other RS-232 equipment). At the other end of the spectrum, a single IOP can manage a CNI board to function as an intelligent, distributed processing network task for the host S-100 bus processor, with full vectored interrupt capabilities.

A NETWORK STANDARD

The Cromemco C-NET is being made available as a multi-vendor, industry-wide standard for micro-computer Local Area Networks.

TECHNICAL SPECIFICATIONS

Controller:
Cromemco Input/Output Processor (IOP) Board

IOP Use:
The IOP functions as a distributed S-100 Z-80A processor with program store to control the CNI in either stand-alone mode or as a task pre-processor for the host S-100 system.

Bus:
S-100 (IEEE-696) and C-bus

C-bus use:
The CNI and IOP are linked with a 50 conductor overhead C-bus cable. The CNI exchanges data, commands and status with the IOP through 10 C-bus I/O ports.

Minimum Network Station:
A complete network station consists of a power supply, an IOP board with downloaded network station software, a CNI board, and a CRT terminal.

Network Interface:
Z-80 SIO serial channel A manages the IOP to network interface. The network channel is operated in SDLC Mode (Byte Synchronous Mode may optionally be used). The network channel may be either transformer coupled to twin-axial balanced lines (C-NET bus cable) with a fixed data rate, or TTL coupled to unbalanced lines with an externally controlled data rate.

Network Modulation:
Synchronous digital, phase encoded

Network Data Rate:
C-NET: 500 Kbps ± .001%
Altmode: 0-880 Kbps, clock externally supplied

RS-232 Interface:
Z-80 SIO serial channel B manages the IOP to RS-232 interface. The RS-232 channel is operated in Asynchronous Mode with a software defined data rate from 75 to 19,200 baud. SIO B controls modem circuits DTR, DCD, CTS, and RTS. Both DTE (CRT) and DCE (Modem) style connections are provided.

Counters/Timers:
A Z-80 CTC supplies four programmable counter/timer channels.

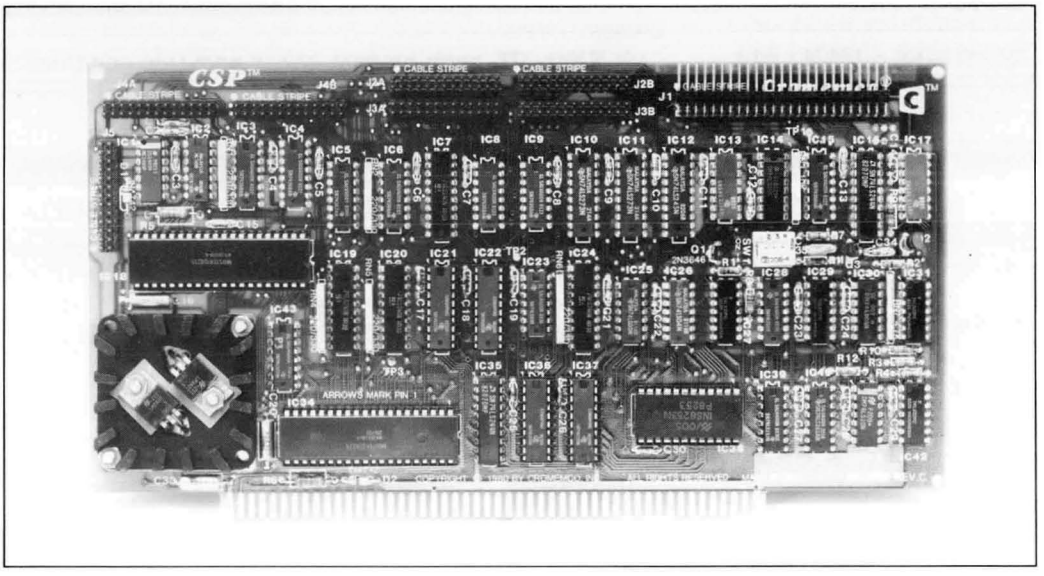
Interrupts:
Both the Z-80 SIO and the Z-80 CTC may be programmed to generate prioritized, maskable and vectored Z-80 IM2 interrupt requests to the IOP.

LSI Device Types:
One Z-80 SIO (Serial Input/Output)
One Z-80 CTC (Counter Timer Circuit)

Power Requirements:
+8 VDC @ 1.2A (max)
−18 VDC @ 150 mA (max)
+18 VDC @ 500 mA (max)

Operating Environment:
0–55 degrees Centigrade

MODEL CSP
Serial/Parallel Interface



This card interfaces to the C-bus of our I/O Processor card and provides general-purpose I/O capability as well as serial communications capability.

The card has three parallel I/O ports and two serial ports.

Two of the three parallel ports are TTL-buffered for general usage. The third port is buffered by a FIFO to permit inputting and outputting of rapid bursts of data. For example, up to 16 bytes can be stored in the FIFO at I/O clock rates up to 10 megabytes/second.

The two serial ports are single full duplex serial channels that facilitate communications applications. One port is for synchronous communication (SDLC or HDLC) at rates up to 800K bits/second.

The second serial port is a serial RS-232C interface for asynchronous communication. It has a programmable data rate of up to 9600 bits/second.

TECHNICAL SPECIFICATIONS

CSP Controller:
Cromemco Input/Output Processor (IOP) board

Parallel Interface:
Compatible with Cromemco Model TDS 9 Track Tape Drive

Parallel Output:
Data: 8 bits wide plus an End of Transfer bit; 16 by 9 bit FIFO buffered; approximately 200K bytes/second maximum continuous (Z-80A I/O Block Move), approximately 10M bytes/second maximum burst (FIFO limited).

Parallel Input:
Data: 8 bits wide; 16 by 8 bit FIFO buffered; approximately 200K bytes/second maximum continuous (Z-80A I/O Block Move), approximately 10K bytes/second maximum burst (FIFO limited).
General Purpose: 16 status bits in two input bytes; vectored maskable C-bus interrupt requests generated on software selected bit states.
Termination: TTL levels; 220/330-ohm terminations on all data and status lines.

Cartridge Modes:
Serial Asynchronous, Synchronous Byte (Bisync) and Synchronous Bit (SDLC) under the management of a Z-80 SIO device; vectored maskable C-bus interrupt requests generated on software-selected status conditions.

Cartridge I/O:
Maximum data rate approximately 800 kbits/second; TxC and RxC clocks supplied by Cartridge peripheral; TTL levels with 220/330-ohm terminations on input lines.

Terminal Interface:
RS-232C DTE connection

Terminal Modes:
Same as Cartridge Modes above although Asynchronous Mode would typically be selected.

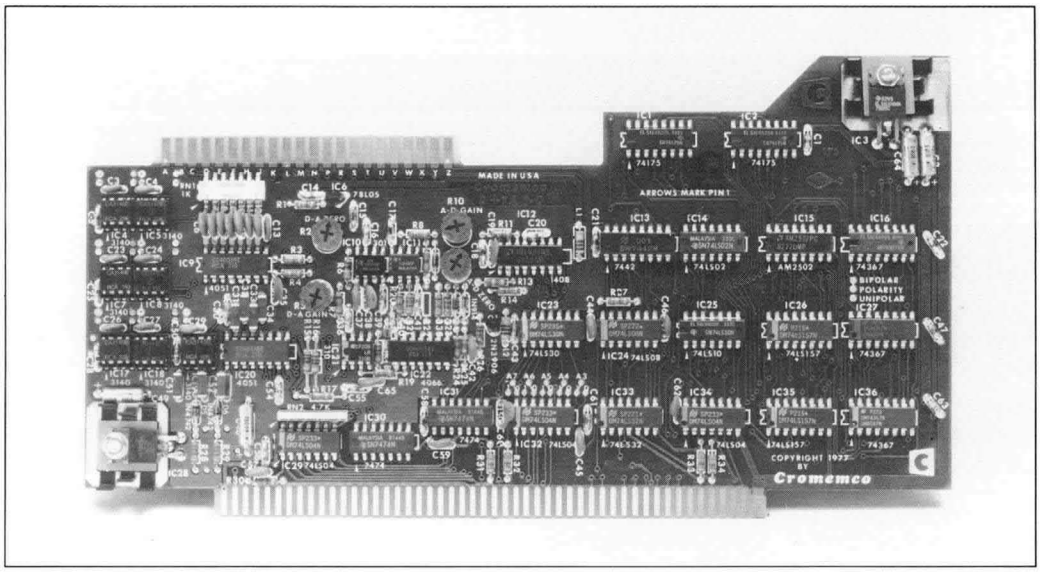
Terminal I/O:
Maximum data rate 9,600 bits/second; TxC and RxC supplied by an on-board timer with software selectable bit rate: RS-232C levels; circuits RTS, CTS, DSR and DCD may be used either for modem control or for general purpose RS-232C level I/O.

Bus:
Standard-100 (S-100) Cromemco Bus (C-bus)

Power Requirements:
+8 VDC @ 1.5A (max)
+18 VDC @ 25 mA (max)
−18 VDC @ 25 mA (max)

Operating Environment:
0–55 degrees Centigrade

MODEL D+7A I/O
Multi-Channel Microcomputer Analog Interface



Cromemco's high performance D+7A I/O gives you a way to get analog information into and out of a microcomputer easily, quickly and inexpensively. The Model D+7A offers 7 channels of 8-bit analog-to-digital conversions (to input analog data to the computer); 7 channels of digital-to-analog conversion (to output computer data in analog form); an 8-bit parallel I/O port to input and output data in digital form; and a fast conversion time of 5.5 microseconds.

A MULTITUDE OF USES

The D+7A makes it easy to use a computer for such jobs as process control, digital filtering, oscilloscope graphics, speech recognition, and speech and music synthesis.

The D+7A lets you input and output analog data with a vareity of devices; such as measurement instruments, machine tools, transducers, control systems, motors, recorders, and plotters.

NO FURTHER SOFTWARE NEEDED

The D+7A I/O plugs directly into Cromemco microcomputers. Analog signal range is from – 2.56 to 2.54 volts (20-millivolt increments) on both input and output sides.

Simple Input and Output instructions initiate A/D conversion and read the ensuing 8 bits of data in or out. No further software is required. During conversion the D+7A holds down the computer "Ready" line.

Each D+7A includes a connector to connect to the 8 input and 8 output ports.

TECHNICAL SPECIFICATIONS

Analog Input Ports:
- Number of input ports: 7
- Input voltage range: – 2.56 to + 2.54 volts
- Input bias current: 2 microamps max.
- Input impedance:
  - 20 Megohms .001 F, 1 kHz sample rate
  - 2 Megohms .001 F, 10 kHz sample rate
- Resolution: 8 bits
- Conversion time: 5.5 microseconds
- Accuracy: + 20 millivolts

Analog Output Ports:
- Number of output ports: 7
- Output voltage range: – 2.56 to + 2.54 volts

Output Impedance: 0.25 ohm
- Maximum load current: 1.5 mA
- Resolution: 8 bits
- Conversion time: 5.5 microseconds
- Accuracy: + 20 millivolts
- Drift rate: Less than 10 mV/sec at 25 C

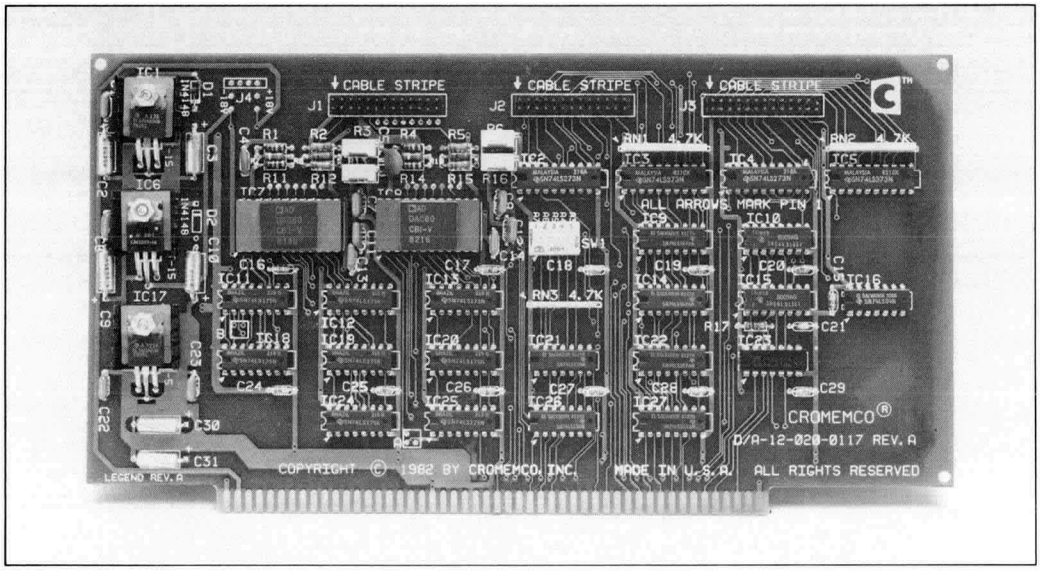
Parallel I/O Port:
- Input port: 8 bits
- Output port: 8 bits
- Input load: One TTL equivalent
- Output drive: 10 TTL loads

Bus:
- S-100

Power Requirements:
- + 8 volts @ 0.4A
- + 18 volts @ 30 mA
- – 18 volts @ 60 mA

Operating Environment:
- 0–55 degrees Centigrade

MODEL DAC12
12-Bit D/A Converter



The Model DAC-12 D/A I/O board provides two independent channels of D to A conversion with a conversion time of 5 microseconds.

TECHNICAL SPECIFICATIONS

D/A converter section

Resolution:
12 bit

Analog Output:
Bipolar voltage: +10V, +5V, +2.5V
Unipolar voltage: 0 to 5V, 0 to 10V
Impedance: 0.05 ohm typical

Conversion Speed (settling time to +0.01% FSR):
+10V output: 5 microsec.

Accuracy:
Offset error/gain error: adjustable to zero
Linearity error: +1/2 LSB (max)

Operating temperature range (no missing codes):
0 to 50 C

Drift:
Gain ±7 ppm/degrees Centigrade (max.)
Linearity ±20 ppm/FSR/degrees Centigrade

Parallel port section

Number of Ports:
2

Output Port Handshake:
Output strobe line on each port

Output Port Drive:
7 TTL unit loads

Sense Line Input Loading:
4 TTL unit loads

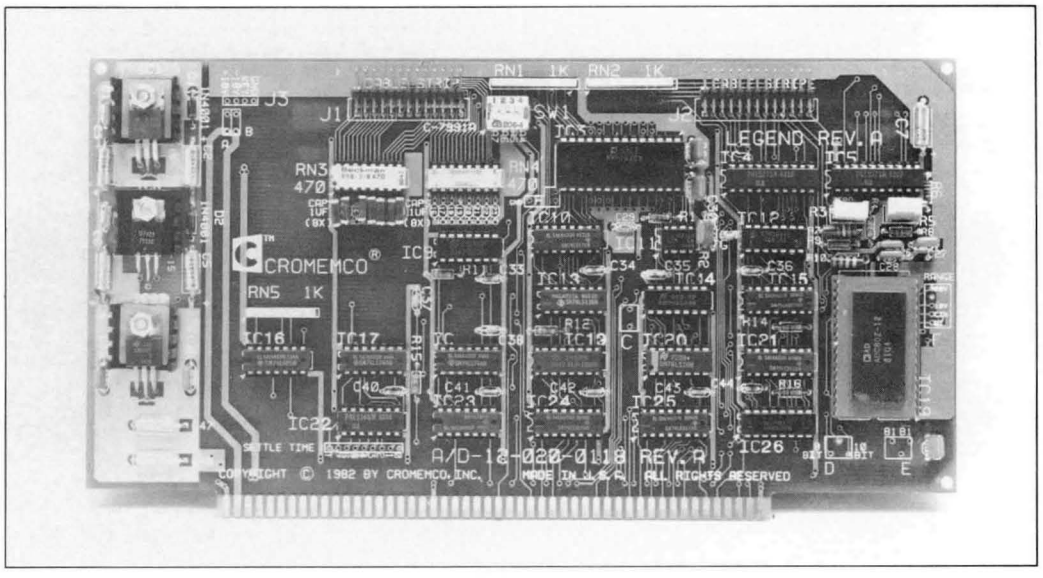
Miscellaneous

Bus:
S-100 (IEEE-696)

Power Requirements:
+8 volts: 350 mA
+18 volts: 120 mA
−18 volts: 100 mA

Operating Environment:
0–55 degrees Centigrade

MODEL ADC12
12-Bit A/D Converter



The Model ADC-12 A/D I/O board provides 16 channels of A-to-D conversion with a conversion time of 30 microseconds.

TECHNICAL SPECIFICATIONS

A/C converter section

Resolution: 12 bit
  Analog input voltage ranges:
    Bipolar: +2.5, +5, +10
    Unipolar: 0 to 5, 0 to 10
Data Acquisition Time:
  30 microseconds
Transfer Characteristics Error:
  Offset error/gain error: adjustable to zero
  Linearity error: +1/2 LSB (max)
Operating temperature range (no missing codes):
  0 to 50 degrees Centigrade
Drift:
  Gain ±30 ppm/degrees C
  Linearity (monotonic operation guaranteed):
    ±3 ppm/FSR/degrees Centigrade

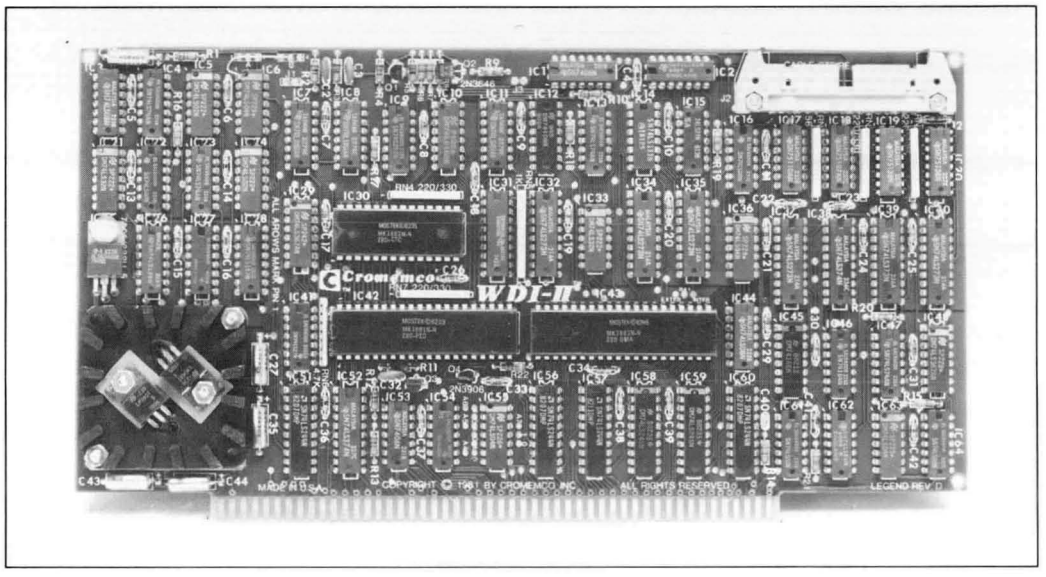
Parallel port section

Number of Sense Lines:
  4
Number of Output Ports:
  2
Output Port Handshake:
  Output strobe line on each port
Output Port Drive:
  7 TTL unit loads
Sense Line Input Loading:
  4 TTL unit loads

Miscellaneous

Bus:
  S-100 (IEEE-696)
Power Requirements:
  +8 volts: 250 mA
  +18 volts: 120 mA
  −18 volts: 100 mA
Operating Environment:
  0 to 55 degrees Centigrade

MODEL WDI-II
Winchester Disk Interface



The WDI provides an interface between the system S-100 Bus and a hard disk drive. The WDI circuits, together with the operating system, format and control data transfer between the system main memory and the disk surface media. High speed memory-to-memory data transfers may be made between addressed locations in system main memory. The extended address function allows extended addressing using address-as-data information received from the S-100 bus.

USER SELECTED OPTIONS

There are two types of user selected options available for the WDI. Interboard functions may be selected using interconnecting cables, and intraboard functions may be selected using onboard jumpers.

The interboard options set up priorities between boards for system bus requests and system interrupts. WDI bus requests are generated by the Address Generator (DMA). WDI interrupts are generated by the Address Generator, CTC (Counter/Timer Circuit), and the PIO (Parallel Input/Output) controller circuits.

SYSTEM COMPATIBILITY

The WDI is designed for use with all Cromemco, S-100 Bus systems. All Cromemco Hard Disk Drives are compatible with the WDI.

TECHNICAL SPECIFICATIONS

Modes and Functions:
- Hard Disk Data Transfer
- Memory-to-Memory Data Transfer
- Extended Addressing

Disk Drive Compatibility:
- Cromemco Hard Disk Drives

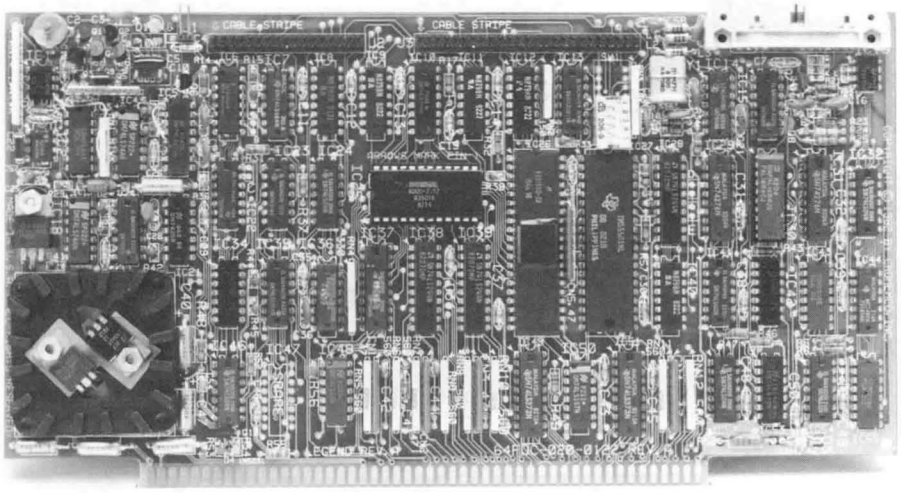
Disk Drive Capacity:
- 4 Maximum

Bus:
- S-100

Power Requirements:
- +8 volts @ 1.4A
- −18 volts @ 0.1A

Operating Environment:
- 0–55 degrees Centigrade

MODEL 64FDC
Floppy Disk Controller



The Cromemco Model 64FDC floppy disk controller board provides a complete system for floppy disk operation including serial I/O for an RS-232 terminal, a pre-programmed Read Only Memory with system bootstrap and diagnostic routines, and full read/write/format capability for any combination of single- or double-sided, single- or double-density five inch or eight inch floppy disk drives. The Model 64FDC normally handles up to four drives in a daisy-chain configuration. Up to sixteen drives may be connected if the drives decode the four drive select lines.

An important feature of the 64FDC is its support of the new slimline eight-inch drives such as are included in the Cromemco System Three. The Model 64FDC includes standard write precompensation to ensure high reliability on the inner tracks of a wider variety of eight-inch drives.

The 64FDC includes a 512 millisecond real time clock for use with the CROMIX multi-user, multi-tasking operating system.

The data recovery circuit on the 64FDC uses a patented phase locked loop to optimize performance for each size and density diskette. The 64FDC also provides an upgrade path for using higher data rates with future generation five-inch floppy disk drives.

TECHNICAL SPECIFICATIONS

Disk Controller:
- Maximum number of 5¼" drives: 4
- Maximum number of 8" drives: 4
- Bootstrap/monitor firmware: 4K byte ROM monitor/boot/diagnostic
- Controller circuitry: MOS LSI

Serial I/O Port:
- I/O levels: RS-232 or 20 mA current loop
- Low baud range: 110–9600 baud (software selectable)
- High baud range: 880–76,800 (software selectable)

Diskette Format:
- Size: 5¼" or 8"
- Sides: Single or double
- Density: Single (FM) or double (MFM) (software selectable)
- Data recovery: analog phase-lock loop (U.S. Patent 4 319 200)
- Write precompensation: Crystal controlled delay generator

Formatted Disk Capacity:

	5¼"	8"
Single-sided, single-density	83K	243K
Single-sided, double-density	190K	600K
Double-sided, single-density	173K	594K
Double-sided, double-density	390K	1216K

Interval Timers:
- Number of timers: 5
- Timer range: 0–16.32 msec (software selectable)
- Timer resolution: 64 microseconds

Bus: S-100

Disk controller type: 1793-B02

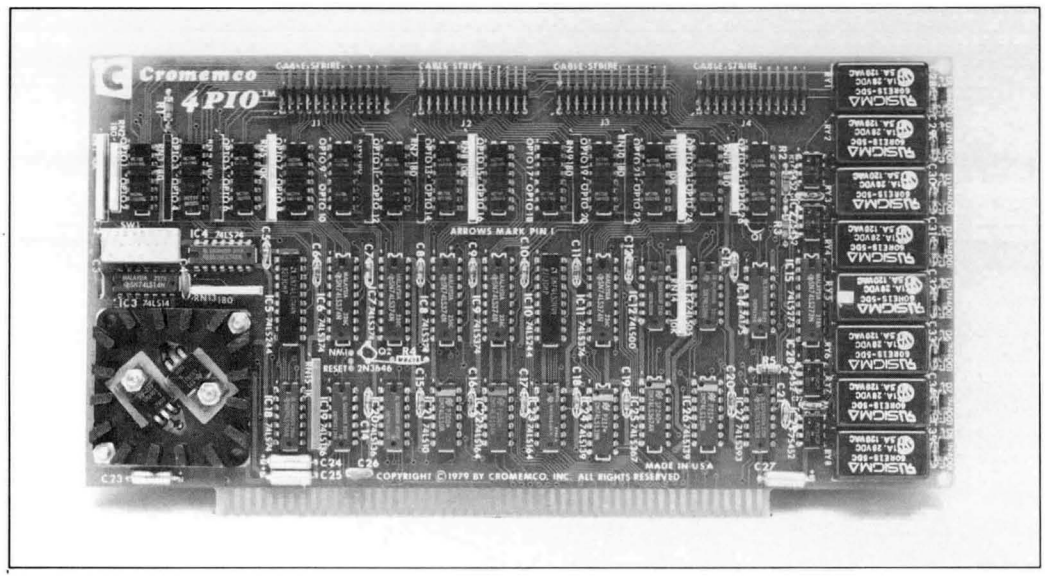
UART type: 5501

ROM type: 2332

Power requirements: +8 volts @ 1.5A
+18 volts @ 100 mA
−18 volts @ 100 ma

Operating environment: 0–55 degrees Centigrade

MODEL 4PIO
4 Port I/O Isolated Parallel Interface



The Cromemco 4PIO Parallel Interface Card allows interfacing with complete electrical isolation from the host microcomputer. Therefore, problems with ground noise and ground loops can be completely eliminated in instrumentation, communications, or process control systems. In addition, potentially damaging transients can be safely isolated from the computer system.

The Cromemco 4PIO parallel interface card includes:

- 24 opto-isolated input channels
- 16 opto-isolated output channels
- 8 relay-isolated output channels
- 11 opto-isolated strobe/handshake lines
- 1 opto-isolated reset line

The 4PIO services these isolated I/O channels through four parallel, 8-bit I/O ports. The addresses of these I/O ports are switch selectable (in blocks of four) by means of a switch conveniently located on the 4PIO interface card.

ISOLATED CONNECTOR PINS

The isolated I/O channels of the 4PIO are brought to four connectors on the top edge of the card. NO PIN ON ANY OF THESE CONNECTORS IS DIRECTLY CONNECTED TO THE COMPUTER CIRCUITRY. Every active pin is electrically isolated by means of an opto-isolator or relay.

TECHNICAL SPECIFICATIONS

Parallel I/O Ports:
- Number of bidirectional ports: 4
- I/O port width: 8 bits
- Number of opto-isolated input ports: 3
- Number of opto-isolated output ports: 2
- Number of relay-isolated output ports: 1

I/O Strobe Signals and Reset:
- Number of I/O strobe bits: 11
- Strobe signal isolation: opto-isolated
- Reset line: opto-isolated

Opto-isolated I/O:
- Number of opto-isolators: 52
- Opto-isolator type: MCT66
- Signal levels: TTL

Relay Outputs:
- Number of relay outputs: 8
- Contact type: SPDT
- Contact voltage: 28V (AC or DC)
- Contact current: 1A

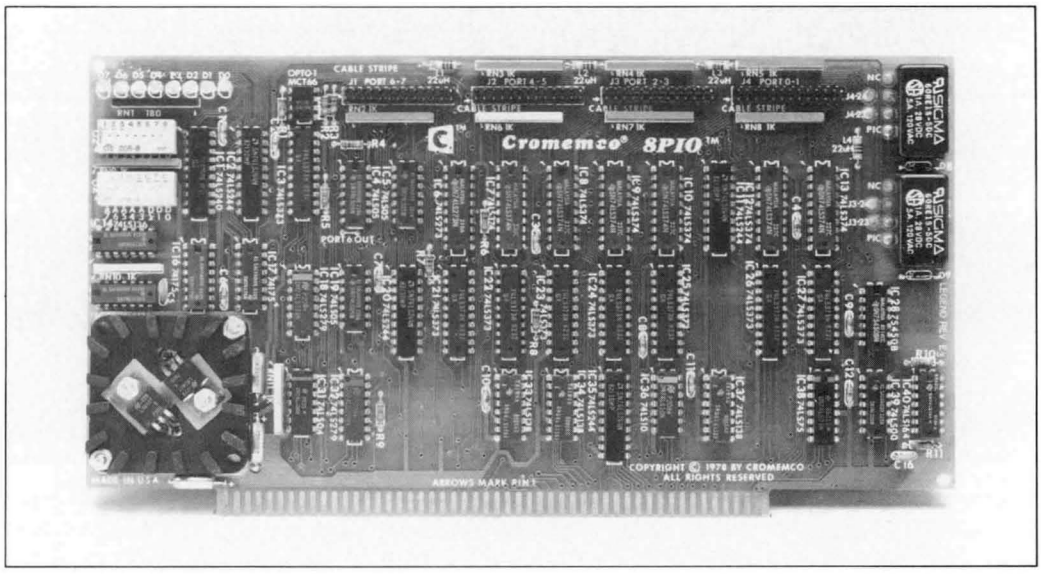
Bus:
- S-100

Power requirements:
- +8 volts @ 2.3A

Operating environment:
- 0–55 degrees Centigrade

MODEL 8PIO

8 Port I/O Multi-Channel Microcomputer Parallel Interface



SIMPLIFIED PARALLEL INTERFACING

Parallel interfacing was never easier than with the Cromemco 8PIO Parallel Interface Card.

The 8PIO provides 8 bidirectional 8-bit I/O ports that can be used singly or coupled together to form longer word lengths.

For convenience, input and output status flags for handshake purposes are grouped together on one port and may be accessed with one input or output statement.

Strobe pulses can be issued after each 8-bit transfer or may be delayed until the proper word length has been formed.

Other features include 8 sense switches and 8 LEDs on the highest selected I/O port on the card, and 2 bits of opto-isolated input and 2 bits of relay-driven output.

The 8 I/O ports may be located on any 8-port I/O boundary.

TECHNICAL SPECIFICATIONS

Parallel I/O Ports:
- Number of bidirectional ports: 8
- I/O port width: 8 bits
- Input load: 4 TTL loads
- Output drive: 4 TTL loads

Input Strobes:
- Latched

Output Strobes:
- Delay: 1 μsec after new data valid
- Width: 1.5 μsec; negative true
- 1 strobe pulse per port

Opto-Isolator Input:
- Number of opto inputs: 2 bits, TTL level inputs

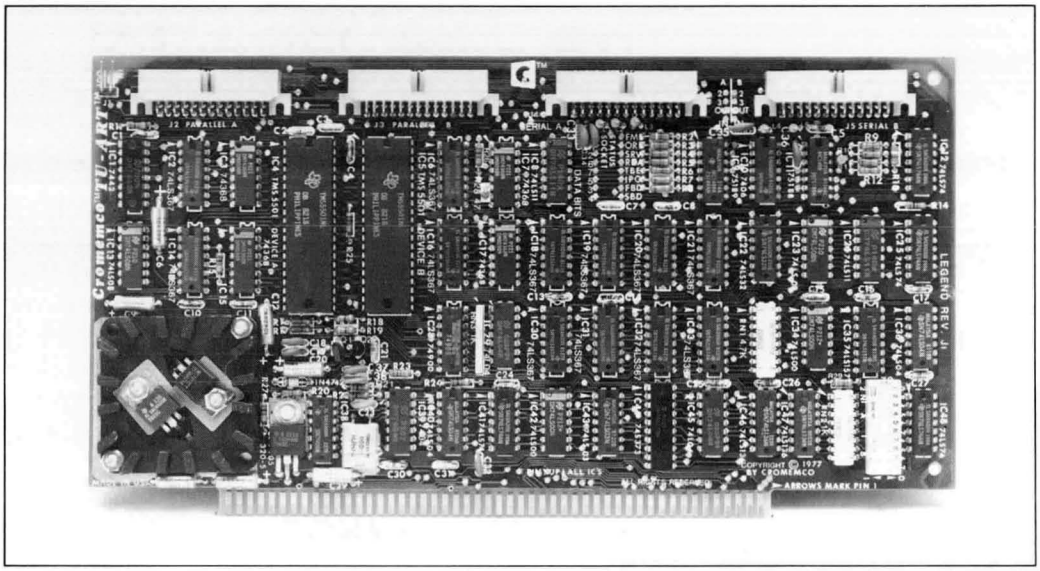
Relay Outputs:
- Number of relay outputs: 2 bits
- Contact voltage: 28V (AC or DC)
- Contact current: 1A
- Contact type: SPDT

Bus:
- S-100

Power requirements:
- +8 volts @ 1.5A

Operating environment:
- 0–55 degrees Centigrade

MODEL TRT
TU-ART Digital Interface



FAST – SOFTWARE SELECTABLE BAUD RATES UP TO 76,800 BAUD

The TU-ART digital interface is a convenient interface to allow coupling to two terminals or other devices, such as line printers or modems.

It has two serial I/O ports, two 8-bit parallel I/O ports, and 10 independently programmable interval timers.

Baud rates are software-selectable from 110 to 76,800 baud.

VECTORED INTERRUPTS

Another special convenience of the TU-ART is its vectored, prioritized interrupts. It is able to support the powerful vectored interrupt structure of the Z-80A microprocessor.

INTERVAL TIMERS

The 10 interval timers have real-time clock capability; therefore, they offer a wide range of control possibilities.

Each timer range is from 0 to 16.32 milliseconds and is software selectable.

See Support System Components Section, page 37, for information on cables to be used with this card.

TECHNICAL SPECIFICATIONS

Serial I/O Ports:
- Number of ports: 2
- I/O levels: RS-232 or 20 mA current loop
- Low baud range: 100 to 9600 baud (software selectable)
- igh baud range: 880–76,800 baud (software selectable)

Parallel I/O Ports:
- Number of ports: 2
- Input ports: 8 bits
- Output ports: 8 bits
- Input load: One TTL equivalent
- Output drive: 20 TTL loads

Interval Timers:
- Number of timers: 10
- Timer range: 0 to 16.32 msec (software-selectable)
- Timer resolution: 64 microseconds

Vectored Interrupts:
- Number of restart locations (8080 mode): 8
- Number of restart locations (Z-80A mode): 65,536
- Prioritization of TU-ART ports: Internally prioritized
- Prioritization for multiple TU-ARTs: daisy-chaining

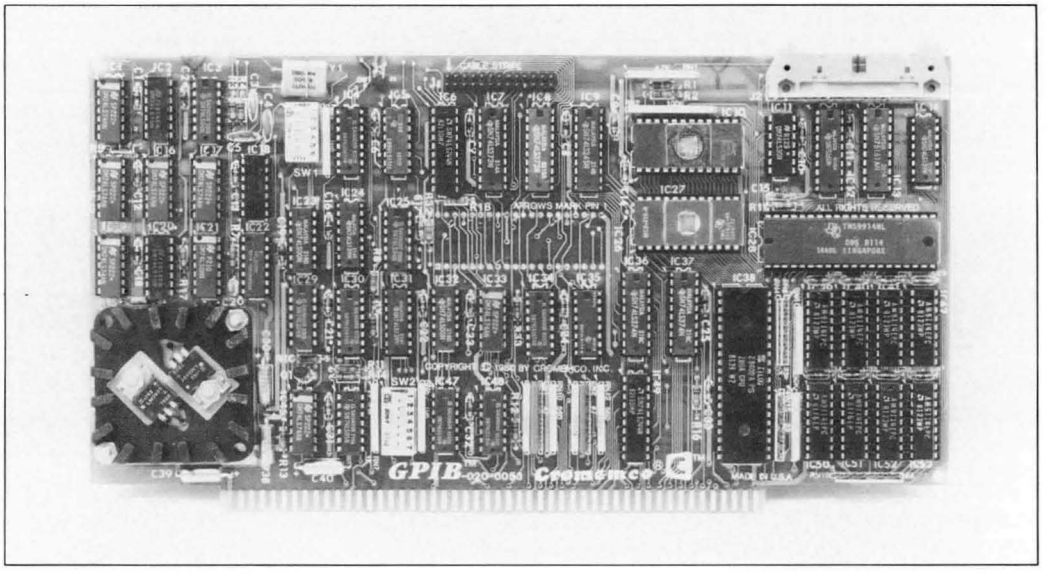
UART type:
- 5501

Bus:
- S-100

Power requirements:
- + 8 volts @ 1.0A
- + 18 volts @ 80 mA
- – 18 volts @ 40 mA

Operating Environment:
- 0–55 degrees Centigrade

GPIB
General Purpose Interface Bus



This card enables you to connect your Cromemco computer to measuring and control equipment that has an IEEE-488 port, the communications standard in instrumentation applications. This allows arrangements such as a computer-operated measuring and control system to be devised.

The Cromemco GPIB card contains a dedicated Z-80A processor along with 4K of RAM and two 2716 sockets that provide for 4K of EPROM. Connectors at the top of the card are for the IEEE-488 interface. There is also a connection for an external TTL parallel I/O port. Switches select the I/O address through which the computer communicates with the card and the address to which the card responds.

The GPIB card can interrupt the host computer over the S-100 bus with either a software maskable or nonmaskable interrupt and is equipped with the Cromemco interrupt priority daisy chain. The dedicated Z-80A on the card can be interrupted by the host, the GPIB chip, or the reception of data from the external input port. On-board priority determination is fully software defined, employing a hardware poll of the possible interrupt devices over a single input port.

TECHNICAL SPECIFICATIONS

IEEE-488 Functions:

C	Controller with Pass Control capability
T, TE, L, LE	Talker and/or Listener
SH, AH	Automatic Source and Acceptor Handshake
DC, DT	Device Clear and Device Trigger
SR	Service Request
PP	Parallel Poll
RL	Remote/Local with Remote Lockout

Processor:
Z-80A clocked at 4.000 MHz

ROM Memory:
Socket space for 4K/bytes of TI 2516, Intel 2716, or their generic equivalents (user supplied)

RAM Memory:
4K/bytes of 9124 (1K × 4) static RAM (included)

S-100 Bus Interface:
Four 8-bit parallel I/O ports; the GPIB card may issue non-maskable interrupt requests to the Host; the Host may issue maskable interrupt requests to the card.

GPIB Bus Interface:
The 24 IEEE-488 bus lines interface to a GPIB card connector.

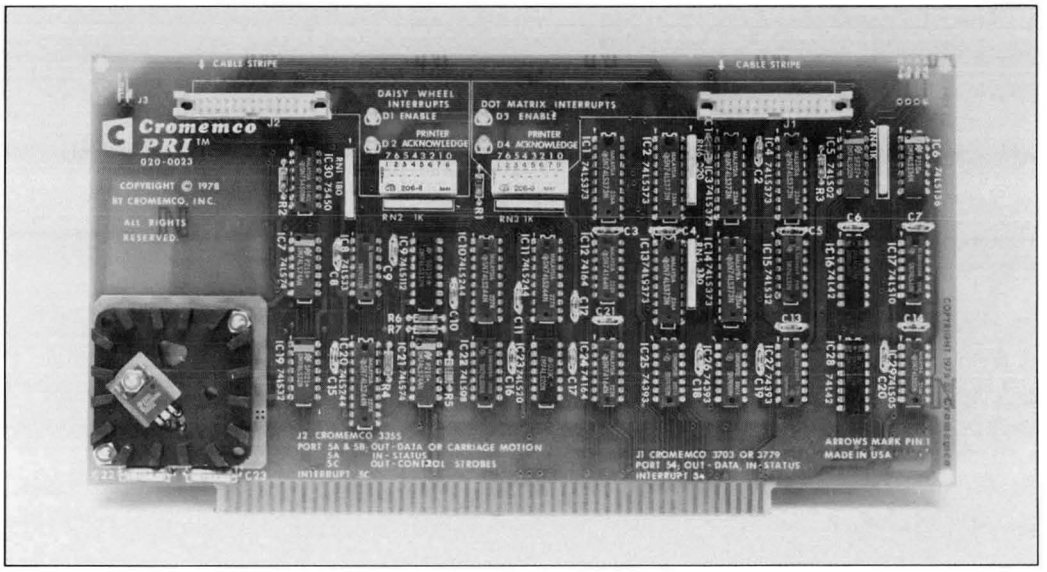
Utility Interface:
One 8-bit parallel input port and one 8-bit parallel output port provide a general purpose interface at a GPIB card connector.

LSI Device Types:
Z-80A CPU, TMS 9914 GPIB Adapter

Power Requirements:
+8 VDC @ 1.5A (max)
± 18 volts not used

Operating Environment:
0–55 degrees Centigrade

MODEL PRI
Printer Interface



A VERSATILE CARD WITH TWO INTERFACES ON ONE CARD

With this interface card, it's easy to interface either dot-matrix or full letter printers to your computer system.

For use with these printers, the PRI is designed with two actual interfaces. One uses the "Centronics parallel" convention and interfaces the Cromemco Models 3715 or 3703 dot-matrix printers.

The second interfaces the Cromemco Model 3355B letter quality printer.

This second interface has built-in ribbon-lift and ribbon-lowering circuitry to free the software overhead normally required for this function.

Each of the two interfaces has an individual cable connection on the top edge of the card.

The Cromemco PRI card also includes full interrupt capability for use in multi-user systems.

TECHNICAL SPECIFICATIONS

Output Port Addresses:
54, 5A, 5B, 5C

Input Port Addresses:
54, 5A

Alternate Port Addresses:
Optional DIP switch

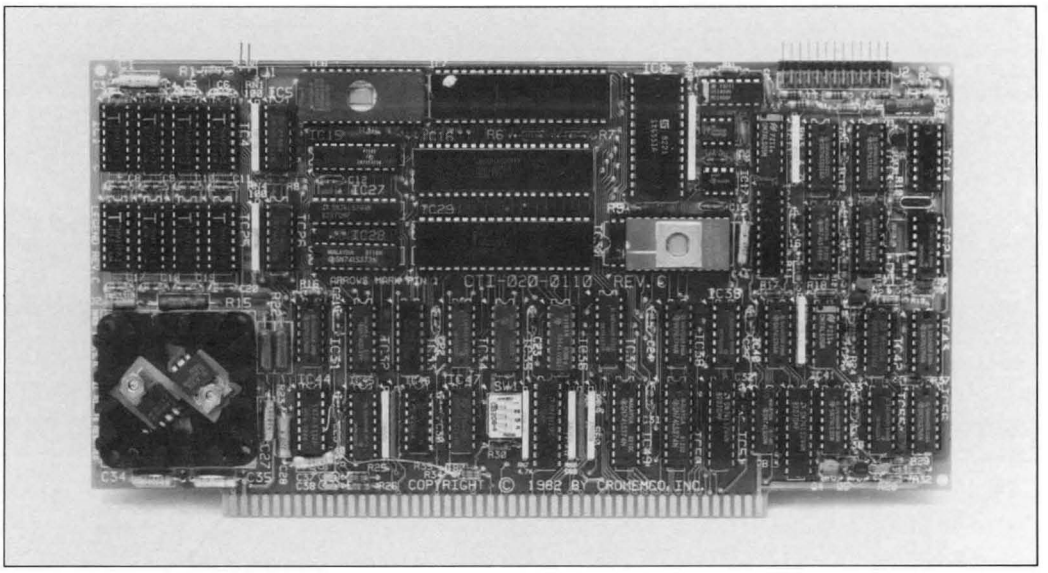
Software Support:
Cromemco CDOS, CROMIX

Bus:
S-100

Power Requirements:
+8 volts @ 1.0A

Operating Environment:
0–55 degrees Centigrade

MODEL CTI
Terminal Interface



The Cromemco CTI Terminal Interface is an S-100 based board designed for use with Cromemco's C-1 video display and CKB series keyboard. The CTI card contains all the display electronics for this full-featured "smart terminal." Four character sets (American, American Bold, Graphics, and Scientific) are supplied in 8K of ROM on the CTI. The ROM can be changed to accommodate special character sets. The CTI can also be used to emulate a Cromemco 3102 CRT terminal. Through its S-100 bus interface, the CTI has an effective data transfer rate of more than 25,000 baud. An additional serial port for driving auxiliary devices, such as a serial printer, is also included on the board. On-board RAM and CPU provides full screen buffering and editing capabilities.

The CTI Terminal Interface card also features the Intel 8275 controller, a high performance DMA Controller, and a versatile UART (for keyboard and serial printer use). For communications to host, the board provides standard S-100 DATA and STATUS port protocols.

TECHNICAL SPECIFICATIONS

Format:
80 characters by 25 lines. Optional status line.

Character Type:
Alphanumeric and Graphic. 512 displayable ASCII characters within 8 × 9 dot matrix. Descenders or lower case characters. Alphanumeric and Graphic characters can be mixed on the screen.

Character Display:
Standard or inverse video. User Programmable.

Tabulation:
Fixed TAB stops

Cursor:
Four types: underline, blinking, underline non-blinking, reverse video blinking, reverse video non-blinking.

Host Communications Interface:
S-100 Bus status and data port

Transmission Rate:
Up to 25,000 baud

Display: (Model C-1)
A standard NTSC video monitor with 12" P31 green phosphor non-glare screen. Optional swivel and tilt stand. All power is supplied by CTI board. Connects to CTI board with a single cable. Monitor back panel has connectors for keyboard, auxiliary serial port.

Bell:
Audible beep from keyboard upon receipt of control G. The continuous alarm On/Off feature is included.

Keyboard: (Model CKBA)
A 60-key ANSI-compatible, TTY/Typewriter compatible layout featuring auto repeat, two key rollover, and alpha lock. The keyboard cable is a 4-wire telephone type coiled cord. The keyboard will operate up to 25 inches from the C-1 terminal. Other features include a programmable keyclick, repeat rate, and numeric pad mode.

Serial Interface:
Printer interface with busy/ready handshake. Data sent to C-1 is also sent to printer when printer is turned on from keyboard. No additional printer interface is required.

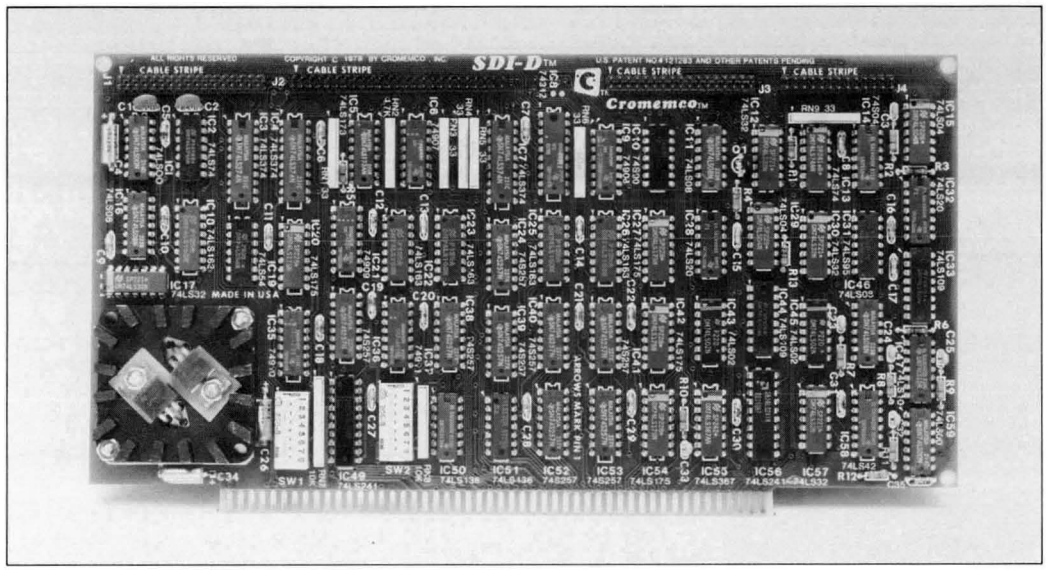
Bus:
Standard 100 (S-100)

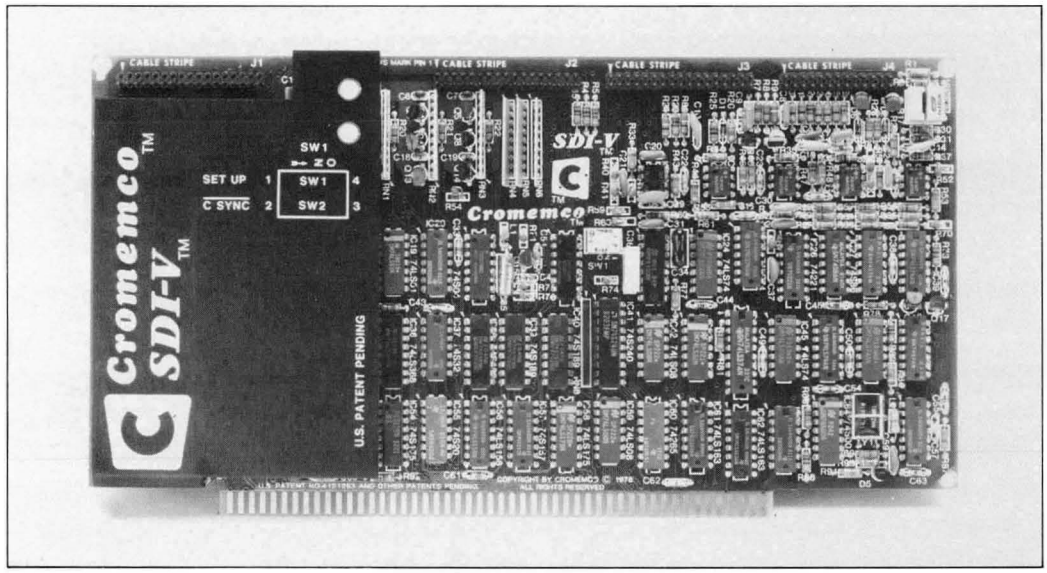
Operating Environment:
0–55 degrees Centigrade

Input Voltage and Frequency:
8 volts @ .5A
+ 18 volts @ 1.5A
– 18 volts @ .1A

HIGH RESOLUTION COLOR GRAPHICS

MODEL SDI
Color Graphics Interface





The SDI graphics interface features high resolution and a wide range of color choices.

It is a fully-integrated way to display the memory content of Cromemco computer systems in beautiful and meaningful color choices. Use of color and the high resolution of the image simplify examination or discussion. Various parts of the scan can be displayed in any of 4096 colors.

The interface consists of two circuit cards that plug directly into any Cromemco computer, without alteration of the computer. All necessary outputs to the monitors are provided by the interface.

The display device is typically an RGB Monitor used in the industry or available from Cromemco (Model RGB-13).

HIGH RESOLUTION

The SDI interface can be used to display images with up to 754 × 482-point resolution. This resolution is at least the equal of a high quality broadcast-TV picture.

COLOR OR B/W

The interface can be used to display an image in either color or black-and-white—or in both simultaneously.

In color any 16 colors from a palette of 4096 colors can be used in the picture. In black-and-white any 16 shades of gray can be used.

HOW THE SDI MAPS

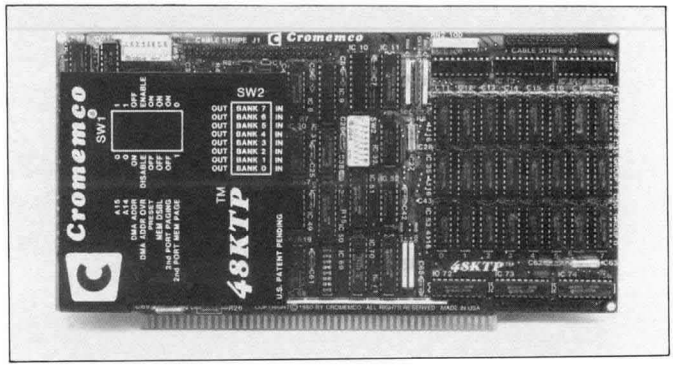
The SDI uses direct memory access to display the content of a display memory. Each pixel of the display may be mapped either from one nybble (4 bits) or one bit of the display memory. The mapping mode (nybble or bit) is software-selectable—in fact, part of a picture may be displayed in one mode and part in the other.

The display memory may consist of either a 12K or 48K memory.

The combination of mapping modes and memory result in four basic modes of operation as shown below:

MODEL SDI RESOLUTION (HORIZONTAL×VERTICAL) IN EACH OF FOUR MODES OF OPERATION

	Display Memory Size	
	12K	48K
Nybble-Mapped	189 × 121	378 × 242
Bit-Mapped	377 × 242	754 × 482



SDI OUTPUTS

The Model SDI provides three separate analog output signals to drive the Red, Green, and Blue guns of a high-quality RGB monitor. The three separate outputs, rather than one composite output, are used to preserve the full resolution of the picture.

In nybble mapped operations each 4-bit nybble can select one of 4096 colors as determined by a mapping RAM. The contents of the mapping RAM can be changed dynamically, under software control, by issuing OUTPUT instructions to the SDI.

TV COMPATIBILITY

The Model SDI also provides all signals required to serve as input to a colorizer or color modulator in a TV broadcast studio.

RGB MONITOR

The Cromemco RGB (red/green/blue) Color Monitor is specially adapted for use with the SDI Interface.

48K DISPLAY MEMORY

The 48K two-port memory card (Model 48KTP) has been developed for use with the SDI. Picture information is accessible by the SDI through a connector on the top of the memory cards. The cards plug directly into the Cromemco computer.

The computer resident memory may also be used as the display memory, although at the expense of mapping speed. This reduction occurs because the CPU must suspend operation when the SDI accesses the resident memory. The result is approximately 55% CPU utilization for a 12K-memory picture and 6% utilization for a 48K-memory picture.

Use of the special two-port memory assures 75% to 100% utilization, depending on the application software.

DESIGNED TO SURPASS TV QUALITY FOR LONG-TERM APPLICATION

In its high-resolution mode, the SDI displays a picture having a 754 × 482-pixel resolution. This format corresponds to and is compatible with NTSC TV systems practice in that 482 lines are normally displayed in a nominal 525-line system. The 754 points in the horizontal direction give a resolution equal to or better than that of the vertical direction.

The result of the above approach is that the high-resolution picture displayed using the SDI interface is at least equal in resolution to a 525-line color TV picture.

TECHNICAL SPECIFICATIONS

Model SDI
Color Graphics Interface

Available Models: SDI-NTSC; SDI-PAL

Mapping Modes: Bit or nybble; software selected

Resolution: 754 × 482 pixels maximum using 48K display memory. 12K display memory may also be used at lower resolution (see text).

Color: Any 16 of 4096 colors or any 16 shades of gray may be displayed.

Outputs: Three analog outputs for RGB monitor

Recommended Display Memory: Cromemco 48KTP two-port memory

Sync Signal: Composite Sync signal is switch-selectable. Separate RS-170 Sync signal available.

System Bus: S-100

Power Requirements: +8 volts @ 2.2A

Operating Environment: 0–55 degrees Centigrade

Model RGB-13 Color Monitor

Max. Effective Screen Size: 255mm × 190mm

Technology: All solid state except for CRT

CRT: 13" shadow mask, delta gun

Video Signal Input: RGB 0.3 to 2.0 volts, 75 ohm. Fully compatible with Cromemco Model SDI interface outputs.

Video Amplifier Bandwidth: 50 Hz to 15 MHz ± 3 dB

Power Requirements: 120 or 220 volts, 50/60 Hz

Power Consumption: 250 VA

Dimensions: 18" × 15-1/4" × 14-3/4"

Weight: 23 Kg

Operating Environment: – 5– 40 degrees Centigrade

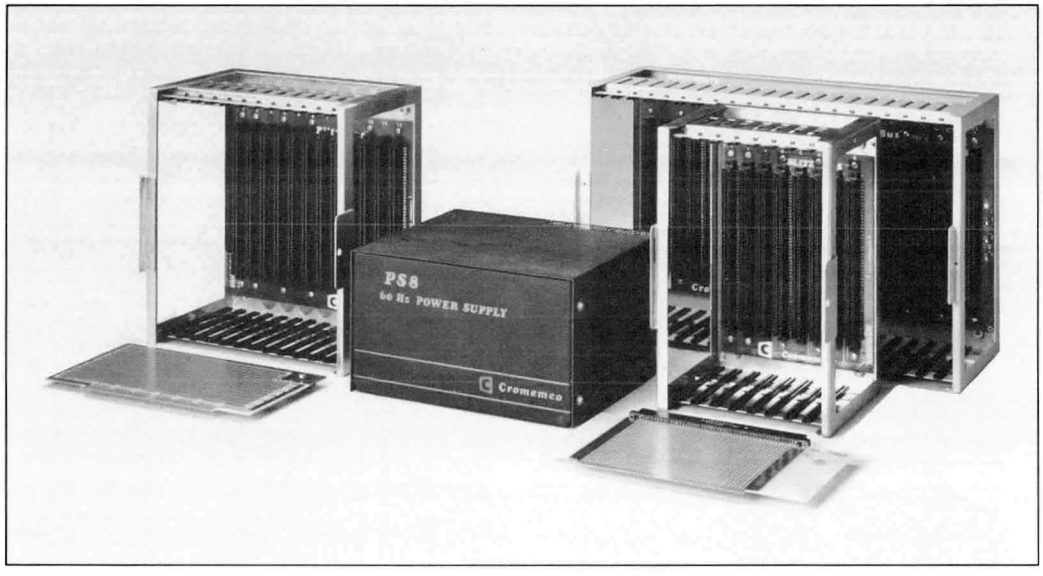
Model 48KTP Two Port Memory

Memory Capacity: 48K bytes

Bus: S-100

Power Requirements: +8 volts @ 1.6A

Operating Environment: 0–55 degrees Centigrade



MODEL WWB
Wire Wrap Extender Cards

The Model WWB is a high-quality wire wrap board for building your own cards for your computer. The Model WWB will hold over 70 integrated circuits. A 5-volt power supply is included on the board.

MODEL EXC
Extender Card

This card is useful for system development. It extends computer boards above the case for easy connection of a voltmeter, logic probe, or oscilloscope and is compatible with all S-100 boards.

MODEL CC-21, MODEL CC-12, MODEL CC-8
Card Cages 8, 12, or 21-Slot Versions

These S-100 bus card cages are ideal for OEM requirements.

The card cages are of sturdy steel construction and include a rugged retaining bar to insure that cards cannot be shaken from their sockets.

The back planes include a full set of edge connectors which are wave-soldered in place on Cromemco's exclusive shielded mother board.

CARD CAGE SPECIFICATIONS

Model	Number of Slots	Dimensions		
		H	W	L
CC-8	8	6-5/8"	10-7/8"	7"
CC-12	12	6-5/8"	10-7/8"	10¼"
CC-21	21	6-5/8"	10-7/8"	16-3/4"

PERIPHERALS

Cromemco systems are available with a wide variety of optional peripherals which allow user to optimize systems for specific applications. These peripherals include terminals, monitors, keyboards, printers, disk subsystems, tape subsystems, and modems.

MODEL PS-8
Power Supply

A convenient power supply to use with Model CC-8 or CC-12 card cage.

Unit provides +7.5 volts @ 12A, +14.5 volts @ 2.5A, and −14.5 volts @ 1A. Ferroresonant transformer design provides for steady output voltage for line voltages 90–130 VAC or 180–260 VAC.

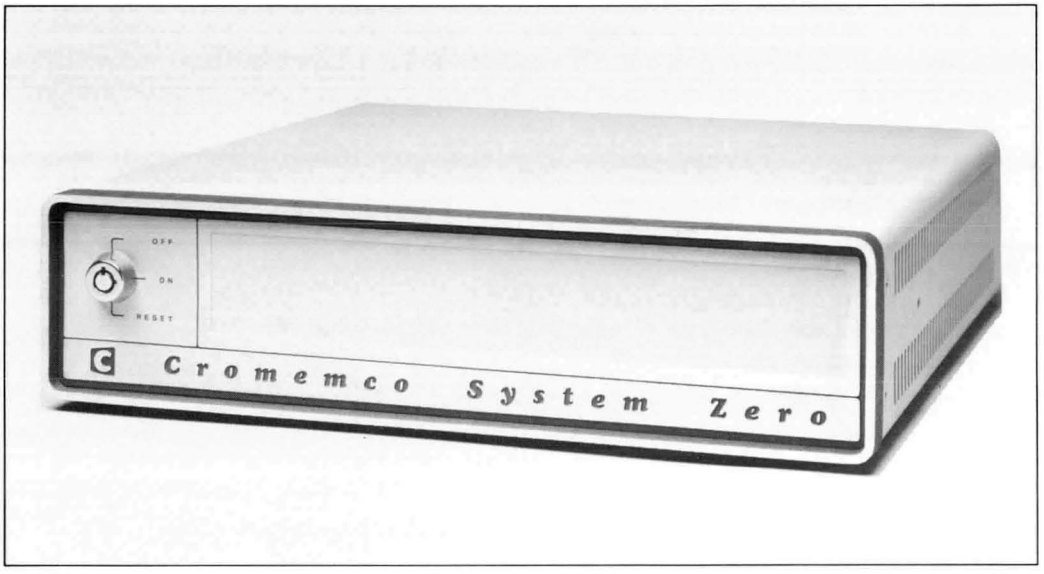
Dimensions: 5-1/2"H × 9-3/4"W × 8"D

Description	Model
60-Hz operation	PS8-60
50-Hz operation	PS8-50

CABLES

Description	Model
System Zero	CBL-1
System One	CBL-1
System Two (62-cm long)	CBL-2
System Three computer (110-cm long)	CBL-3

SYSTEM ZERO



The System Zero (Model CS-0) is designed for development of systems based on Cromemco's Single Card Computer (Model SCC). The CS-0 has four S-100 slots, one of which is occupied by the SCC. Cromemco's Monitor and Control Basic firmware (MCB-216) is included.

The Monitor allows the user to read and modify memory locations and registers and exercise input and output ports. Break points can also be set, a valuable feature when debugging software.

Control BASIC is an integer basic designed to help get the application up quickly. Special commands are provided to directly access I/O ports, to directly read and write memory locations, and to call machine-language subroutines.

Once software is developed it can be burned into PROM memory quickly and easily using the Cromemco 32K BYTESAVER programmer (not included with the System Zero). Programs can then be executed directly from the BYTESAVER, or the PROMs can be installed in the extra sockets on the SCC for resident execution.

TECHNICAL SPECIFICATIONS

Processor:
4 MHz Z-80A

Cycle Time:
250 nanoseconds

Minimum Instruction Execution Time:
1 microsecond

Instruction Set:
158 instructions including the 78 instructions of the 8080A processor

System Bus:
Industry standard S-100

Board Capacity:
4 boards

Boards Supplied:
SCC

RAM Memory:
1Kb

ROM Memory:
8Kb

Firmware Provided:
RDOS

Power:
Operates from 110/120/220/240 volts; 50/60 cycle

Operating Environment:
0–55 degrees Centigrade

Dimensions:
14.2"W × 3.45"H × 13.4"D

Weight:
15 lbs.

Mounting:
Cabinet; optional rack-mount brackets available (Model RMB-0)

SYSTEM ONE

The System One is an 8-slot S-100 bus system which can be used for Z-80A or 68000 system development. The basic System One (Model CS-1) comes with Cromemco's Z-80A processor (ZPU), floppy disk controller (16FDC), and 64K RAM memory (64KZ). The unit has two 5-1/4" floppy disk drives with 780K storage capacity.

The hard disk version of the System One (Model CS-1H) substitutes a 21 Megabyte Winchester hard disk drive for one of the floppy drives and includes Cromemco's WDI, Winchester Disk Interface.

The CS-1 and CS-1H can also be configured with Cromemco's DPU board in place of the ZPU to allow both Z-80A and 68000 software development.

The System One can take advantage of all the software listed in the software section that follows.

TECHNICAL SPECIFICATIONS

	Z-80A Based Systems		68000 and Z-80A Based Systems			
	CS-1	**CS-1H**	**CS-1D2**	**CS-1D5E**	**CS-1HD2**	**CS-1HD5E**
Processor	Z-80A		68000 and Z-80A			
Clock Rate	4 MHz		68000: 8 MHz / Z-80A: 4 MHz			
Instruction Set	158 instructions including the 78 instructions of the 8080A processor		68000: Over 1000 instructions in 56 main types / Z-80A: 158 instructions including the 78 instructions of the 8080A processor			
RAM Memory	64Kb		256Kb	512Kb (ECC)*	256Kb	512K (ECC)*
ROM Firmware	RDOS		RDOS and Diagnostics			
Serial Interface	RS-232 or current loop		RS-232 or current loop			
Processor Control	N/A		Software controlled switching between 68000 and Z-80A			
Floppy Disk Storage	780Kb	390Kb	780Kb	780Kb	390Kb	390K
Hard Disk Storage†	None	21 Mb	None	None	21 Mb	21 Mb
Board Capacity	8 boards		8 boards			
Boards Supplied	ZPU, 64KZ, 16FDC	ZPU, WDI, 64KZ, 16FDC	DPU, 256KZ, 16FDC	DPU, MCU, 512MSU, 16FDC	DPU, 256KZ, WDI, 16FDC	DPU, MCU, 512MSU, WDI, 16FDC
Bus	S-100		S-100			
Power	Operates from 100/115/130/220/240/260 volts; 50/60 cycle		Operates from 100/115/130/220/240/260 volts; 50/60 cycle			
Power Supply	+8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A		+8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A			
Dimensions	14.2"W × 7.0"H × 17.8"D		14.2"W × 7.0"H × 17.8"D			
Weight	45 lbs.	51 lbs.	45 lbs.	46 lbs.	51 lbs.	52 lbs.
Mounting	Cabinet; optional rack-mount brackets available		Cabinet; optional rack-mount brackets available			
Operating Environment	0–40 degrees Centigrade		0–40 degrees Centigrade			

*ECC stands for error checking and correction.
†Unformatted.

SYSTEM TWO

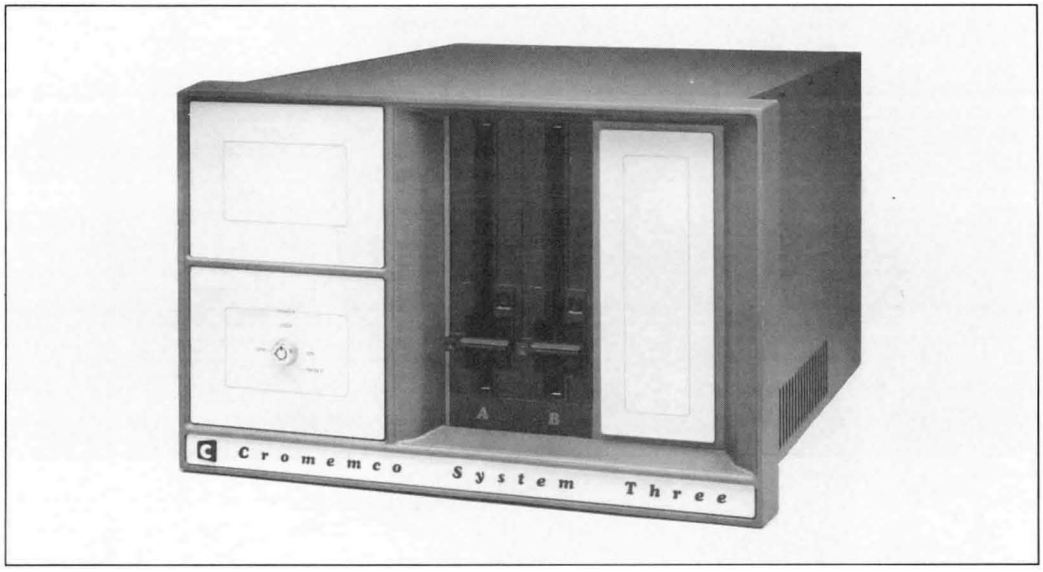
The System Two (Model CS-2) is designed for rack-mount use and has 21 S-100 card slots. Like the System One, it uses 5¼" floppy disk drives and can be outfitted with either Cromemco's ZPU or DPU central processor. An optional 21 Megabyte Winchester hard disk drive (Model HD-20) is also available.

TECHNICAL SPECIFICATIONS

	Z-80A Based Systems		68000 and Z-80A Based Systems			
	CS-2	**CS-2H**	**CS-2D2**	**CS-2D5E**	**CS-2HD2**	**CS-2HD5E**
Processor	Z-80A		68000 and Z-80A			
Clock Rate	4 MHz		68000: 8 MHz Z-80A: 4 MHz			
Instruction Set	158 instructions including 78 instructions of the 8080A processor		68000: Over 1000 instructions in 56 main types / Z80A: 158 instructions including 78 instructions of the 8080A processor			
RAM Memory	64Kb		256Kb	512Kb (ECC)*	256Kb	512Kb (ECC)*
ROM Firmware	RDOS		RDOS and Diagnostics			
Serial Interface	RS-232 or current loop		RS-232 or current loop			
Processor Control	N/A		Software controlled switching between 68000 and Z-80A			
Floppy Disk Storage	780Kb		780Kb			
Hard Disk Storage†	None	21 Mb	None	None	21 Mb	21 Mb
Board Capacity	21 boards		21 boards			
Boards Supplied	ZPU, 64KZ, 16FDC	ZPU, WDI, 64KZ, 16FDC	DPU, 256KZ, 16 FDC	DPU, MCU, 512MSU, 16FDC	DPU, 256KZ, 16FDC, WDI	DPU, MCU, 512MSU, WDI, 16FDC
Bus	S-100		S-100			
Power	Operates from 100/115/130/220/240/260volts; 50/60 cycle		Operates from 100/115/130/220/240/260 volts; 50/60 cycle			
Power Supply	+8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A		+8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A			
Dimensions	12-1/4"H × 19"W × 20-3/4"D (31.1 × 48.3 × 52.7 cm)		12-1/4"H × 19"W × 20-3/4"D (31.1 × 48.3 × 52.7 cm)			
Weight	56 lbs.	62 lbs.	56 lbs.	57 lbs.	62 lbs.	63 lbs.
Mounting	For Rack Mounting		For Rack Mounting			
Operating Environment	0 to 40 degrees Centigrade		0 to 40 degrees Centigrade			

*ECC stands for error checking and correction.
†Unformatted.

SYSTEM THREE



The top-of-the-line System Three (Model CS-3A) uses 8-inch floppy disk drives (1.2 Megabyte capacity each) and has 21 S-100 card slots. The hard disk version (Model CS-3H) replaces one of the 8-inch floppy drives with a 21 Megabyte Winchester hard disk drive.

The System Three can be used for Z-80A software development when equipped with the ZPU card or for both Z-80A and 68000 software development using the DPU card. The 21 card slots of the System Three mean that a DPU based system can easily accommodate 4 Megabytes of memory using Cromemco's 512MSU memory storage units.

TECHNICAL SPECIFICATIONS

	Z-80A Based Systems		68000 and Z-80A Based Systems			
	CS-3A	**CS-3H**	**CS-3D2**	**CS-3D5E**	**CS-3HD2**	**CS-3HD5E**
Processor	Z-80A		68000 and Z-80A			
Clock Rate	4 MHz		68000: 8 MHz / Z-80A: 4 MHz			
Instruction Set	158 instructions including the 78 instructions of the 8080A processor		68000: Over 1000 instructions in 56 main types / Z-80A: 158 instructions including the 78 instructions of the 8080A processor			
RAM Memory	64Kb		256Kb	512Kb (ECC)*	256Kb	512Kb (ECC)*
ROM Firmware	RDOS		RDOS and Diagnostics			
Serial Interface	RS-232 or current loop		RS-232 or current loop			
Processor Control	N/A		Software controlled switching between 68000 and Z-80A			
Floppy Disk Storage	2.4 Mb	1.2 Mb	2.4 Mb	2.4 Mb	1.2 Mb	1.2 Mb
Hard Disk Storage†	None	21 Mb	None	None	21 Mb	21 Mb
Board Capacity	21 boards		21 boards			
Boards Supplied	ZPU, 64KZ, 64FDC	ZPU, WDI, 64KZ, 64FDC	DPU, 256KZ, 64FDC	DPU, MCU, 512MSU, 64FDC	DPU, 256KZ, WDI, 64FDC	DPU, MCU, 512MSU, WDI, 64FDC
Bus	S-100		S-100			
Power	Operates from 100/115/130/220/240/260 volts; 50/60 cycle		Operates from 100/115/130/220/240/260 volts; 50/60 cycle			
Power Supply	+8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A		+8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A			
Dimensions	12-1/4"H × 19"W × 20-3/4"D (31.1 × 48.3 × 52.7 cm)		12-1/4"H × 19"W × 20-3/4"D (31.1 × 48.3 × 52.7 cm)			
Weight	84 lbs.	90 lbs.	84 lbs.	85 lbs.	90 lbs.	91 lbs.
Mounting	For Rack Mounting		For Rack Mounting			
Operating Environment	0-40 degrees Centigrade		0-40 degrees Centigrade			

*ECC stands for error checking and correction.
†Unformatted.

C-10 Personal Computer

The Cromemco C-10 personal computer product line meets the most exacting professional needs at a very affordable price.

The basic C-10 includes the Z-80A microprocessor, 64K bytes of RAM, 24K bytes of ROM, and a high resolution 12" green phosphor CRT capable of displaying 80 columns and 25 lines of text or 160 columns and 72 lines of business graphics characters.

The C-10SP Super Pak provides the same high quality Cromemco C-10 computer plus a keyboard and a 5¼" disk drive with 390K capacity. A variety of software packages are also included with the Super Pak such as a word processor, a financial spread sheet, Structured BASIC, an investment analysis program, the CDOS operating system (Cromemco's enhanced version of CP/M), and complete operating instructions.

The keyboard, screen, and system layout are the result of an extensive human factors engineering program that provide maximum comfort and efficiency.

The C-10 uses Cromemco's enhanced version of CP/M which allows the user access to the extensive library of current CP/M programs and to the wide variety of advanced programming languages available from Cromemco. This gives the user access to higher level languages such as FORTRAN, COBOL, RATFOR, and LISP. Furthermore, software programs that are developed for use with the C-10 can be used on larger Cromemco systems—even the high performance, 68000-based, multi-user computers.

The C-10 can emulate a wide variety of terminals and data protocols. Several units can be interconnected and used as distributed work stations, interfaced to larger Cromemco systems, or used as front end processors for mainframe computers.

A number of options are available for the C-10 including a second 5¼" floppy disk drive, a letter-quality 120-words-per-minute Daisy wheel printer, and a swivel-and-tilt ergonomic stand.

TECHNICAL SPECIFICATIONS

Processor: High speed Z-80A microprocessor operating at 4 MHz clock frequency

Internal Memory: 64K bytes of internal Random Access Memory. 24K bytes of internal Read Only Memory

Operating System: Cromemco's enhanced CP/M operating system

Display: High resolution 12" CRT for professional quality displays and graphics
- Graphics modes:
  - Pixel: 160 × 72
  - Line: High resolution (720 × 384)
  - Character: Special graphic characters
- P-31 green phosphor, standard
- 25 lines of 80 characters each
- Four character sets included:
  - ASCII, Boldface, Graphics, Scientific/Technical

Data Communications: RS232 serial data communications port, Parallel I/O expansion and printer port, Serial printer port. Can emulate a wide variety of terminals and protocols.

Peripherals: 5¼" floppy disk available with 390K bytes storage capacity per diskette. Up to two drives per system. Daisy wheel letter-quality printer.

Software:
- Operating system
  - WriteMaster Word Processing
  - PlanMaster Spread Sheet Calculator
  - MoneyMaster Investment Analysis
  - Structured BASIC
- Also available: RATFOR, COBOL, FORTRAN, LISP, Macro Assembler, Spelling Correction Program, Variety of CP/M programs.

The disk-based software for the System One, System Two, and System Three systems is among the best and most extensive in the industry. When ordering software for a System One or System Two, add a "-S" suffix to the software model number to indicate software on a 5" diskette. For the System Three, add a "-L" suffix to indicate an 8" diskette.

OPERATING SYSTEMS

There is a choice of two operating systems for ZPU-based systems. CDOS is an enhancement of the industry-standard CP/M operating system and is designed for single-user, single-task applications. CROMIX is a UNIX-like system designed for single-user, multi-tasking or multi-user, multi-tasking applications.

For DPU-based systems, a special version of CROMIX, called CROMIX-D, is available. CROMIX-D is a single- or multi-user, multi-tasking system, where different users or tasks can run under either the Z-80A or 68000 processor of the DPU. CROMIX-D must be installed on a DPU based system in order for that system to be able to take advantage of the 68000-based software languages listed below.

OPERATING SYSTEMS AND DIAGNOSTICS

Description	Model
CROMIX Multi-user, Multi-tasking (68000-based systems)	CRO-DS/L
CROMIX Multi-user, Multi-tasking (Z-80A Based Systems)	CROMIX-S/L
Z-80A CDOS Single-user	DOS-S/L
Cromemco Diagnostics Software	CDS-S/L

68000 LANGUAGES

Description	Model
68000 Macro Assembler	ASM-D-S/L
68000 C Compiler	CCC-D-S/L
68000 COBOL Compiler	COB-D-S/L
68000 FORTRAN 77	FOR-D-S/L
68000 Pascal Compiler	PAS-D-S/L
68000 BASIC	STB-D-S/L

Z-80 LANGUAGES

Description	Model
C Compiler	CCC-S/L
Z-80 Macro Assembler	FDA-S/L
16K Extended BASIC Incremental Compiler	FDB-S/L
COBOL Compiler	FDC-S/L
FORTRAN I/V Compiler	FDF-S/L
RATFOR	FDR-S/L
LISP Interpreter	LSP-S/L
RPG-II Compiler	RPG-S/L
Structured BASIC	STB-S/L

SOFTWARE TOOLS (For Z-80A Based Systems)

Description	Model
Cromemco Overlay Linker	COLL-S/L
Data Base Management System	DBM-S/L
Dazzler Graphics Software	DGR-S/L
IOP Development Software	IDS-S/L
Keyed Sequential Access Method	KSAM-S/L
Remote Batch Terminal Emulator	RBTE-S/L
SDI Graphics Software	SGS-S/L
Tri-SDI Software	TSDI-S/L
Word Processing Software	WPS-S/L

MASTER SERIES (End-User Tools)

Description	Model
WriteMaster, Word Processing	WRMR-S/L
SpellMaster, Spelling Correction Program	SPMR-S/L
PlanMaster, Spreadsheet Analysis	PLMR-S/L
SlideMaster, Custom Graphics	SLMR-S/L
FontMaster, standard fonts for adding text or generate custom fonts	FOMR-S/L

DEDICATED TO QUALITY

Cromemco, Incorporated, the world's largest and most successful S-100 based microcomputer manufacturer, is known for high-quality, high-reliability products.

Cromemco has, from the beginning, set a goal of building "tomorrow's computers today." We place tremendous importance on continuing R&D on system products, software, manufacturing and testing techniques, and support for our many customers. Cromemco products have achieved a world-wide reputation for high quality at a reasonable price.

The company operates its office, laboratory, and manufacturing facilities in a modern complex in Mountain View, California. Every step in the manufacturing process is controlled in-house and considerable attention is paid to quality control and reliability engineering.

Every product, whether it's a single board or the most complex computer, is thoroughly tested and burned-in before leaving the factory.

More than 35,000 Cromemco computers are now at work around the world. Acceptance has been world-wide thanks largely to a strong network of experienced dealers and distributors.

Cromemco has been recognized by leading industry experts as one of the fastest growing corporations in the country and now ranks among the top 100 firms in the data processing industry. The advanced, high quality software available to our customers is one reason why Cromemco systems are often used in applications where maximum reliability is essential: business and finance, engineering and control, medicine, scientific research and TV weather reporting.

And since we have always used extensive engineering to make our systems rugged, many of our customers choose Cromemco systems for applications in tough environments: industrial process control, offshore oil rigs, robotics, ship-board and in-flight systems.

Manufacturing: Quality builds reliability

Since 1975, when our first S-100 boards were introduced, we have recognized the value of close quality control over every step in manufacturing.

The value to our customer is consistent, reliable, repeatable performance—board to board, system to system.

The value to Cromemco has been in seeing our boards and systems accepted throughout the computer world as quality standards, as documented in a recent study done by Bunker Ramo for the U.S. Air Force.

The fact that our products are being widely used by the most demanding systems integrators of engineering and office systems is quiet testimony to the excellence of our manufacturing process and quality control.

It starts at incoming QC

All components are hot-rail tested against the manufacturer's toughest specs, then put through DC parametric tests for all device functions.

Bare boards are checked for shorts and opens and baked for 24 hours prior to assembly.

Complex LSI devices are pretested on specially-designed test systems.

We maintain constant vigilance over quality throughout the assembly process. We perform a variety of visual and computer-controlled electrical inspections on every assembled board to make sure every device is functioning properly. Every part of every system is essential to the reliable operation of your equipment.

By the time our S-100 boards or systems are packed for shipment, each has already run successfully in our own test area, has passed a complex series of performance tests and has gone through burn-in. Quality controls, uniformly and consistently applied, are the only way to assure long-term reliability.

Service closes the loop

Finally, to close the quality loop, we give our customers the best possible documentation, training, and field support because we know that long-term profitable growth will come only from completely satisfied end users. We have worked hard to build and keep a reputation for concerned, capable, professional service after the sale. Third party service is available nationwide to Cromemco customers from TRW Customer Service Division.

INTERNATIONAL ASSOCIATION OF CROMEMCO USERS

News on products and applications is available to the world-wide base of Cromemco users through the International Association of Cromemco Users (IACU), an independent users group formed in 1980. The purpose of the IACU is to act as an independent two-way communications center for Cromemco users. Through their publication, I/O NEWS, the Association serves as a clearinghouse for information about Cromemco products, applications, available software and services, and dealers.

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SALES SUPPORT OFFICES

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